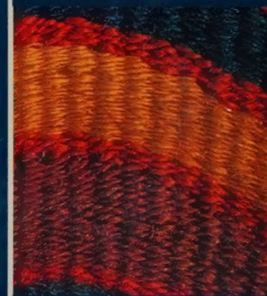
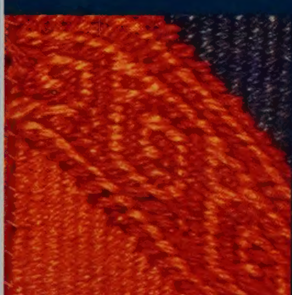


The Primary Structures of Fabrics

An Illustrated Classification



IRENE EMERY

$75.00
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The Primary Structures of Fabrics
An Illustrated Classification

IRENE EMERY

Fabric classification and terminology have always been minefields of conflicting, inconsistent, and inadequate usage. Even the word "textile" (from the Latin *texere*, to weave), properly applied to *woven* "fabrics," is in popular idiom often used to mean "fabric" in general – the generic term for all fibrous constructions, with which this book is concerned. Irene Emery's innovative approach to how to construct a logical and comprehensive system of terminology for describing fabrics in a precise way was immediately recognized as a classic when it was first published in 1966.

Based on many years of study of a huge range of fabrics produced by hand or by strictly limited mechanization, this book's essential strength is its universality: For the first time, whether the purpose of study is an aspect of design, history, or cultural significance, and regardless of its scope chronologically or geographically, a definition of the actual structural makeup of fabrics and their component parts is clear and accessible to all.

Unlike process, social context, or symbolic function, structure is – with negligible exceptions – always determinable; it can be objectively observed; and it is varied enough for significant grouping and sub-grouping. In this monumental work, moreover, the structures, and the descriptive terms applied to them, are clearly presented according to their logical relationships to each other, generally moving from the simplest to the most complex.

Illustrated with specially constructed and photographed examples made from cotton string and with extant fabrics from different cultures, the book is divided into three parts: the raw materials of fabric structures (fibres, filaments, and fabric elements); then, in the major section of the book, the fabric structures themselves, whether felted – derived directly from fibres – or made from interworked yarns; and, lastly, structures – such as stitches or appliqué – that are accessory to fabrics.

The result is a completely indispensable book, now made widely available, for all handweavers, craftworkers, industrial designers, art and textile historians, anthropologists, and archaeologists.

368 pages. 9 x 12 inches (22.8 x 30.4 cm).
376 black-and-white illustrations.
Bibliography. Index.

WATSON–GUPTILL PUBLICATIONS

The Primary Structures of Fabrics

THE PRIMARY STRUCTURES OF FABRICS

An Illustrated Classification

BY IRENE EMERY

WATSON-GUPTILL PUBLICATIONS/WHITNEY LIBRARY OF DESIGN
THE TEXTILE MUSEUM, WASHINGTON, D.C.

A NOTE ON THIS PRINTING

The Primary Structures of Fabrics was first published by The Textile Museum, Washington, D.C., in 1966. In 1980, the book was reissued, not as a fully revised edition, but with some brief changes in the text. A number of captions were also revised or rewritten in the interest of greater clarity and consistency. Asterisks in the text refer to an Addendum (pp. 340-341) where a limited number of paragraphs of new or slightly extended and reworded material appear.

Thanks are due to Holly Myers and Joan Griffin for valuable help in preparing these changes and to Ann Rowe for meticulous and knowledgeable editing.

In 1994, Thames and Hudson (in London) and, in 1995, Watson-Guptill (in New York), in collaboration with The Textile Museum, reprinted the 1980 edition unchanged except for a new dust jacket design.

On the jacket. All photographs are details of pieces from The Textile Museum collection. Clockwise from left: Plain weave, embroidered in cross-stitch, silk on linen, possibly Spain, 16th c. 84.23 / Plain interlacing, with 2- and 3-span floats to create pattern, cedar bark, mat, NW Coast USA, probably Makah people, 19th-20th c. 1963.14.20 / Oblique 4/4 twill interlacing, camelid fiber, bag, south coast Peru, late Nasca style, 6th-7th c. 91.354 / Tapestry weave with exaggerated use of non-horizontal or eccentric wefts (see p. 83), cotton warp, camelid fiber weft, south coast Peru, late Inca style, 16th c. 91.146 / Plain weave, with discontinuous warps and wefts interlocked, side stripes with occasional 3-span warp floats, camelid fiber, poncho, south coast Peru, Ocoña, 15th-16th c. 1965.48.1 / Weft-twining, with both half and full turns, cotton, bag, Indonesia, north Sumatra, Toba Batak people, 19th c. 1987.15.1. Gift of Fred and Rita M. Richman / Strips of weft-faced plain weave sewn to strips with diagonal bands in a double-faced weave structure with complementary sets of weft and weft-faced plain weave with discontinuous wefts. Cotton warp, camelid fiber weft, central coast Peru, Chancay style, 13th-15th c. 91.297.

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To

Kenneth M. Chapman

Preface

As an archaeologist, involved with the wealth of textile material one finds in Peru and northern Chile, I welcome this volume. I have heard colleagues, collectors, and others complain that they did not understand fabric construction and that they could not find any simplified presentation of textile differences and distinctions. They no longer can use such an excuse. By this I do not mean to imply that Miss Emery's text was planned specifically for archaeologists or any other group with limited or specialized interests. It is, in a sense, an encyclopedia with subject matter arranged in logical order rather than alphabetically, a presentation useful to a wide audience, from enquiring laymen to experienced textile specialists. Some undoubtedly will wish that certain sections had been expanded to include more variations of certain techniques, for no work of this scope can satisfy everyone. All, however, will profit if they will first familiarize themselves with the organization and presentation of the information.

Miss Emery's approach has stressed the fact that a visual demonstration is worth far more than words; that verbal explanations should be so placed that the eye and mind can easily seek orientation from the illustrations. In organizing the subject matter she has developed and followed a simple, over-all, basic plan. The fabrics considered are first divided into two categories: those made directly from fibers, and those made of interworked yarns. The latter division, constituting the major part of the classification, is in turn subdivided into fabrics constructed from a single yarn or element, fabrics made with a single set of elements, and those with two or more sets, all handled in a variety of ways. There may be protests that this is oversimplification, that it is misleading; yet there is no intent on Miss Emery's part to make an issue of debatable aspects or to be adamant in her interpretation. Her sole purpose is to provide an easily followed path, marked by successive steps and divisions leading to an understanding and correlation of a multitude of products.

The history of this study is a long one, as the record of acknowledgements will indicate. Miss Emery's intelligence, skill, and dedication have earned support from many individuals and various institutions. For the past ten years the work has been carried on at the Textile Museum, starting when Mr. George Myers, founder, invited her to join the staff and culminating in the present publication during the directorship of Mr. Alan Sawyer.

As a trustee of the Textile Museum, I believe our faith in the project has been fully justified. With this volume in hand, the way has been cleared for greater understanding in the confused realm of textile classification and terminology, not only in our own language but on an international, interlingual basis. Those who have for some years tried to correlate textile terms used in different parts of the world have been thwarted by the conflicting, inconsistent, and often inadequate terms in any one language. With the exposition of structure as presented here, one can foresee the preparation of understandable glossaries in any language, provided they are correlated with this text and its definitive illustrations.

New York, January 1965 — Junius B. Bird

Table of Contents

Foreword

THE DESCRIPTIVE CLASSIFICATION of fabric structures presented here is based on a long and wide-ranging study of representative fabrics from ancient and primitive cultures, and of the methods and terminology employed in analyzing, describing, and classifying them. After a number of years of collecting and attempting to collate available data, the bewildering inconsistencies and incongruities encountered in museum records and labels, and in published descriptions and discussions, led me to undertake a detailed and systematic investigation of the essential characteristics of ancient and primitive fabrics and the problems involved in acquiring, recording, and transmitting information about them.

Initial analysis of the problem led to the formulation of certain convictions which have served as working hypotheses:

1. If technological information about a given fabric is to contribute to knowledge in any field of fabric study, two things are essential: someone must understand and be able to record its technical nature, and the recorded information must be communicable.

2. Technological analysis and description constitutes only one of many aspects of fabric study. It can be separated from, or correlated with, such other aspects as design, historical development, and cultural use and significance, according to the interests of individuals or the requirements of individual studies. In practice, each aspect is further delimited – sometimes chronologically, sometimes geographically, sometimes technically – and the fact that each aspect tends to have its own specialists and its own specialized nomenclature clearly contributes to the general problem of terminology.

3. Although special terms may be required for phases and details that are peculiar to one or another aspect of fabric study, a basic vocabulary of essential terms, mutually understandable and free of special connotations, is necessary if information from one field (or individual) is to be available to others for comparative or other purposes.

4. A 'basic vocabulary of essential terms' presupposes a comprehensive classification of fabric forms on a basis common to all of them.

5. While there are many possible bases for classification, it is the actual structural make-up of the fabrics and their component parts that provides data integral to virtually all fabric studies, regardless of the nature or origin of the fabrics, the special interest of the investigator, or the special purpose of the study. Structure is never absent; it is, with negligible exceptions, determinable; it can be objectively observed; and it is varied enough for significant grouping and sub-grouping. Although the details of structure (and element make-up) do not in themselves give a complete picture of a fabric, they provide a sound factual basis for more comprehensive description and, being determinable data, for comparative studies and for classification.

6. Although an exhaustive knowledge of fabrics is not required, some understanding of the basic principles governing their construction and their structural variety is essential to an accurate and unambiguous statement of even quite simple details; and words alone will almost inevitably prove inadequate.

7. Some idea of the full range of fabric forms and concepts is prerequisite not only to setting up a system of classification but to appraising the problem of communicating information. In view of the variety of approaches to the study of fabrics, neither the nature of the problem nor the possibilities of solution can be determined unilaterally. Investigation cannot be limited to consideration of the fabrics of any one area, any one period of time, or any one type of manufacture. Nor can it be confined to any one point of view — the industrial designer's, the hand weaver's, the art historian's, the anthropologist's. Diversity must be sought and the range of diversity explored — in fabrics, in recorded information about them, in the definition and use of terms for them, and in opinions and points of view.

A statement of the general problem, formulated in 1947, opened with the following paragraph:

> There has been confusion for a long time in the matter of describing fabrics. Both method and terminology have been haphazard, varying from writer to writer, from time to time, from place to place, and from one field of fabric study to another, so that as technical studies of groups of fabrics increase in number, the confusions, far from being cleared up, are not only added to numerically but put into wider circulation.

The intervening years have brought increased recognition of the inadequacies and inconsistencies of fabric description and terminology and increasingly frequent and determined efforts by both individuals and groups to standardize vocabulary and to reduce the seemingly haphazard diversity of technological analysis and description. There is less evidence of work on over-all classification and there continues to be a tendency to construe the problem of accurate transmission of information as a purely terminological one to be solved by redefining and occasionally coining terms.

A review of many assemblages of definitions (in glossaries, dictionaries, vocabularies) suggested that the greatest hindrance to the eventual achievement of a workable vocabulary — one that would meet the requirements of lucid and accurate description — lay in the failure to differentiate between generic and specific terms. Without generic, or classifying, terms, even the simplest vocabulary is unwieldy; the welter of fabric terms makes their use imperative. The nearly infinite possibilities of variation, particularly in the non-mechanized construction of fabrics, seems to have discouraged over-all classification; and yet classification, by providing a basis for using general as well as specific terms and qualifying phrases, seems to offer the only means of re-ordering the elaborately confused terminology which now keeps so much of our necessarily incomplete and inadequate information about ancient fabrics from being communicable.

It seemed clear that it was time for someone to attempt to correlate the widest possible range of fabrics and terms, and by classifying the fabrics, to determine where generic terms would serve and where specific terms or descriptive phrases were required.

The study was limited to ancient fabrics and those that might be termed 'primitive' in that they can be constructed with a minimum of mechanization, which meant chiefly that the elaborations of weave and pattern building coincident with such elaborations of mechanical equipment as the drawloom (and the later Jacquard) would not be studied in detail. The basic types of structure can all be found in fabrics developed with little elaboration of equipment, and the essential relationships between structures are frequently easier to detect in those forms. All elaborations derive from basic structures and can be described in terms of them, if the relationships are understood and if there is a well-defined and accepted terminology for the basic structures.

The investigation was necessarily many-sided. In the initial study of fabrics, the primary aim was to seek out and record details of the range and nature of structural variation. Over a thousand specimens (from the collections of a number of individuals and about twenty museums), selected

largely for their technical diversity, were analyzed; their structural detail was recorded; and data from catalogue cards and labels were added to the record. The analyses were corroborated by reconstruction, and in this way a file of several hundred woven and otherwise constructed examples of fabric structure was built up. The accompanying exercise in the use of terms was no less valuable for being incidental.

Concurrently, the literature of the various fields of study was being searched for published descriptions, discussions, and diagrams of as great a variety of fabrics as possible. A file of definitions, possible foreign-language equivalents, and excerpted examples of descriptive and explanatory usage was compiled; any overt or implied classification was noted; and attempts were made to identify and, when possible, to reconstruct the fabric structures referred to – for correlation with the records and reconstructions of the specimens that had been analyzed at first hand. In addition, individual concepts of the relative significance of various aspects of fabric study and individual interpretations of terms and their meanings were gleaned through discussion with collectors and curators, scholars and specialists in various fields.

This study of the records, the literature, and the language of fabrics provided an extensive record of the vagaries of usage and an objective basis for evaluating the effectiveness of different terms. General problems of language and usage, of vocabulary building, and of the relationship between terminology and classification were studied, too, for clues to the nature and possible solution of the specialized but not unusual problems with which we are faced.

A 38-page descriptive outline of the classification, with 116 illustrations of the basic forms and selected types of variations, was completed in 1953. It was not published, but was used and tested by the author in the subsequent fabric studies. By 1954 the text had been considerably expanded and the number of illustrations nearly doubled; the semi-outline form had been retained but the types of variation were more fully presented. The basic studies of fabrics, terms, and classifications continued, along with the work of filling out the various series of illustrative constructions of variations. In 1956 definite plans for publication were made, and it was decided that the outline form should be replaced by fuller exposition and that the critical discussion of the use of terms should be comparably extended.

In the descriptive, illustrated classification of the primary structures of fabrics as now presented, I have attempted to survey the range of structures and to describe and illustrate those that exemplify the principles of each basic group and some that distinguish certain major types of variation. I have tried, at the same time, to explore the scope of fabric terminology and to correlate the structures that are illustrated with some of the terms that have been used for them, noting the use of some of the same terms for other structures and suggesting criteria for evaluating the relative accuracy and definitive value of different terms and phrases for the same thing. The selection of structures to be illustrated was based on the classification and on the classificatory significance of the interrelationship of structures and the range of structural variation. It does not reflect the relative extent of the use of the structures or their relative significance in fabric development and history. Those who find the treatment of the area of their special interest disappointingly curtailed will perhaps be reminded, by that apparent shortcoming, of the fact that any one field of fabric study – no matter how important – is at most only a part of a large and highly diversified subject.

An earnest plea is made for care and thoughtful consideration in the use of fabric terms – care in selecting each term and consideration not only of what is intended to mean but of what other meanings it may convey and of how it may be translated. It is hoped that this book will prove to be an aid to general understanding of the nature and interrelationship of fabric structures and of terms and thereby contribute to the clarity and accuracy of communication of information.

ACKNOWLEDGEMENTS:

So many institutions and individuals have contributed in such a variety of ways, both to the lengthy and diverse studies on which this book is based and to the actual preparation of the material for publication, that it would be impossible to detail my indebtedness. I must hope, therefore, that even those not mentioned specifically will realize the depth of my appreciation and accept this grateful acknowledgement of invaluable assistance.

For financial assistance, I am especially indebted to the *Laboratory of Anthropology* in Santa Fe, New Mexico (and the *Museum of New Mexico*, of which it became a part) for sponsoring and housing the work from its inception in 1947 until 1954, and to a number of individuals interested in the project and its place in the Laboratory program who supported the work at the Laboratory and other museums for nearly five years; to the *Wenner-Gren Foundation for Anthropological Research* for a grant which made it possible to widen the investigation by study at additional museums throughout the country and to complete (and prepare for publication) the first brief illustrated outline of the classification; to the *John Simon Guggenheim Memorial Foundation* for a fellowship which permitted further extension of the investigation and preparation of a second, enlarged, version of the illustrated classification; and to the *Textile Museum*, which has supported the work since 1954 and is now publishing the results in this much expanded form.

I appreciate having had the privilege of access to the collections, records, and libraries of many museums and individuals; and I am immeasurably indebted to all the museum and library staffs – and especially to my co-workers at the *Laboratory of Anthropology* and the *Textile Museum* – for cooperation and all kinds of help. The value of their comments and criticism and of discussion with them and with many visiting colleagues from this and other countries cannot be overestimated.

For the photography which has been so essential a part of the work and its presentation, I owe a great debt of gratitude to the late Warren Gilbertson, for the initial experimentation and for the first 200 of the series of nearly 700 photographs of structural detail from which the illustrations were selected; to Laura Gilpin, of Santa Fe, for applying her skill and experience to the task of matching the already established scale and quality and adding another 150 photographs to the series; to Ernest Johansen (then of the *Museum of International Folk Art*) for the photographs of felt and bark-cloth; and to Joseph A. Bowen (of the *Smithsonian Institution*) for integrating a final 350 superb photographs with the series.

Special thanks are due to Mrs. Anne Blinks, who took an enthusiastic and active part in several aspects of the investigation and wove a number of illustrative examples of weave structure.

Finally, I wish to thank all those who have helped to prepare the work for publication – especially Mildred Mott Wedel, for her invaluable editorial and typing assistance with much of the manuscript and the bibliography, as well as for the initial work on the index; Janet Vaughn Koch, for long hours of critical and painstaking editing and proofreading; and Mary L'Hommedieu Tank, for a major part in setting up and formulating the index.

To Dr. Kenneth Chapman, for his early and crucial interest in the project and the unfailing enthusiasm with which he continued his efforts in behalf of the work over the years, and to Dr. Junius Bird, for the generosity of his uncounted contributions of time, knowledge, critical appraisal, and encouragement, I can only say – quite inadequately – thank you.

Textile Museum, January 1965 IRENE EMERY

Organization and Use of the Book

KEY TO THE CLASSIFICATION

The over-all organization of the work is presented in outline form under the heading KEY TO THE CLASSIFICATION. This serves as a detailed table of contents of the illustrated technical text. It also indicates the points at which the sequence of the classification is broken by a discussion of terms (and/or a list of sources of information) relevant to the preceding section, and by repetition of the part of the Key that relates to the succeeding section.

CLASSIFICATION

The work is divided into three major but not equal parts: the components of fabric structures (fibers, filaments, and fabric elements); the fabric structures themselves; and structures (stitches, fabrics, objects) that are accessory to fabrics. The emphasis is necessarily on PART TWO, which comprises classification, description, illustration, and discussion of the terminology of the primary fabric structures and their major types of variation.

The *structures* of fabrics have been classified with as little reference to *process* (construction method) as possible, since *structure* inheres in the fabric and its elements and is almost invariably ascertainable; whereas evidence of *process* is seldom retained. The general arrangement is on the basis of increasing structural complexity: from the use of a single element or set of elements to the use of many; from simple structures to compound; from simple modes of interworking to complex. Correlation of this progression with either known or postulated chronological development, with geographic range, or with elaboration of method varies greatly and is only incidentally referred to.

Since classification based on structure is not affected by qualitative differences in fabrics, the endless visual and tactile variations produced by variations of color, finish, or the quality of component threads or yarns are not specifically discussed or illustrated. The illustrative constructions themselves vary only in structure, that is, in the spatial and quantitative relationships between elements. The occasional use of different colored elements is solely for the purpose of clarifying or emphasizing structural distinctions.

ILLUSTRATION

The majority of the illustrations show models that are, in effect, generalizations of fabric structure in which the element is constant and only the spatial and quantitative relationships between elements are variable. Most fabric structures are known in many guises, some more familiar than others. The use of an invariant element-of-construction automatically limits the range of possible variation in appearance and tends to divorce the concept of each structure from habitual associations with certain specific fabrics and fabric qualities.

After extensive experimentation with various yarns and threads, a particular grade of 12-ply cotton 'string' was chosen for its visually nondescript character and lack of specific fabric association, plus a degree of flexibility that made it relatively adaptable to the widely differing requirements of the great range of fabric structures to be illustrated. Each illustrative construction was made with this 'string' and with simple implements and equipment – usually the simplest of those commonly used that was compatible with the practical mechanical requirements of the technique. For single-element and other non-loom constructions, an eyed needle, netting needle and gauge, crochet hook, knitting needles, 'sprang' frame, cardboard 'tablets,' et cetera were used; for warp-weft structures, either a 2-shaft 2-bar loom or a 4-shaft direct-control counterbalanced floor loom – sometimes supplemented by a pick-up stick and in a few instances (e.g. for *satin weaves*) replaced by a loom with additional shafts as required. Each structure is shown approximately in the position in which it was constructed, and in all warp-weft constructions the warps are shown running vertically. 'Close-worked' and 'open' (diagrammatic) examples of the same structure were made with identical implements, and if loom-made, both versions were woven on the same warp and the same warp set-up (occasionally re-sleyed for 'open' construction in order to correlate the warp spacing with a wider spacing of the wefts).

In addition to the specially made illustrative examples, archeological, ethnographic, or historic fabrics are used to illustrate certain details of fabric structure. All the photographs were taken for and in collaboration with the author, except those used for figures 260 and 261, which are by courtesy of Dr. Junius Bird and the American Museum of Natural History. With the exception of six that were among a number woven for the purpose at the Textile Museum by Mrs. Anne Blinks, the illustrative constructions and fabrics without stated provenience are the work of the author.

Inasmuch as the structural *identity* or *dissimilarity* of the two faces is an essential and often differentiating factor in the identification of a fabric structure, it is noted throughout this study. Except in a very few instances, if the two faces of an illustrated fabric are structurally *dissimilar*, both are shown. When the 'opposite face' was photographed, the fabric was turned side for side (reversed right for left), except when the structural relationship between the two faces in each area could be made more immediately comprehensible by showing corresponding areas of the two faces in the same relative positions.

Since illustration is an essential part of any descriptive delineation of fabric structure, the illustrations are closely correlated with the text – even at the expense of descriptive detail and, where necessary, of page design. Almost without exception, each illustration appears on the page with, or on that facing, the primary description and discussion of the structure. Unless otherwise noted, the enlargement shown is approximately x 1⅓.

USE OF TERMS

Terms are used throughout to designate fabric structure, not to name fabrics. That is, a distinction is made between *fabric names*, which designate aggregates of specific fabric characteristics such as fiber, element make-up, texture, color, finish, use, et cetera, in addition to structure; and *terms* for fabric structures, which refer specifically and usually solely to the relationships between fabric elements.

The terms *fabric* and *textile* are differentiated on the basis of their literal meanings and derivations: *fabric* (from the Latin *fabricare*, to make, to build, to 'fabricate') as the generic term for all fibrous constructions; *textile* (from the Latin *texere*, to weave) to refer specifically to *woven* (i.e. *interlaced* warp-weft) *fabrics*.

Italics are used for technical *terms*, and for words used with technical implications, rather than for emphasis.

Relatively few words are specifically defined. When delineation of a category of fabric structures rests on the exact meaning of a word or on a clear distinction between words, the words are defined. These definitions (which appear in slightly indented paragraphs) are not quoted directly from any one source; they are composite definitions and include elements found to be common to a number of different definitions recorded from a variety of sources. Specific examples of usage are only occasionally documented, since most of those discussed are common to so many different authors that documentation of each use made the discussion of terms unwieldy and prohibitively long.

These composite definitions and all references to and discussions of the *use of terms* were based on the terminology file, a compilation of more than 3,000 excerpted definitions and examples of descriptive and explanatory usage, supplemented by evidences of usage deduced from the correlation between published diagrams and their captions or confirmed in conversation.

Brief comments on terms and on the variety of terms for specific structures are made from time to time throughout the illustrated text, but more extensive analytical and critical discussion of the variant uses of certain specific terms will be found in special sections that follow the presentation of each major category of fabric structures. In these sections, under the general heading NOTES ON THE USE OF TERMS, selected pairs or groups of terms (often applicable to the same structure) serve as specific headings under which their relative applicability and their divergent (often contradictory) uses are discussed at some length. Since it would be clearly impossible for anyone to be cognizant of (much less find space to discuss) every known application of every variant term, neither the listing nor the discussion of terms is exhaustive. The intent is to relate some widely used terms, in the most common of their variant uses, to the structures delineated in this volume. By indicating both the number and variety of different terms that have been used to refer to a single fabric structure, as well as the number and variety of fabric structures that have been referred to by a single term, we have hoped to alert the reader to the possibilities of misinterpretation and to the imperative need for careful consideration in making and interpreting statements about fabric structures.

NOTES

The text is broken from time to time for the insertion of paragraphs of comment set in slightly smaller type and headed NOTE. These comments are set off from the body of the text, not because they are less significant but because they diverge slightly in one way or another from the sequence of classificatory headings and sub-headings. They may suggest possible categories of variation when full discussion is unwarranted; they may call attention to some particularly noteworthy example of variation, some common misconception, or some possible source of confusion. Footnotes have not been used; bibliographic and cross references are included in the text.

SOURCES OF INFORMATION

Under the heading SOURCES OF INFORMATION (pp. 259 ff.), after a brief statement of the basis for selection and exclusion, bibliographic data are given for a majority of the publications con-

sulted during both the investigative studies and the preparation of this volume. The abbreviated references under the same heading at the end of each of eleven major divisions of the technical text are to publications with content pertinent to the preceding text. Publications dealing wholly or primarily with fabrics and/or their components are listed as GENERAL TECHNICAL REFERENCES. Listed as SPECIFIC USES are publications dealing with certain specific fibers and/or fabrics; with fibers and/or fabrics from certain specific areas, cultures, or periods of time; and with fabrics produced by certain specific ethnic groups, with those in specific collections, or with those produced in some specific manner. Some of the 'specific-use' references that are very brief and lacking in detail were included for the purpose of documenting either the geographical, cultural, or chronological range of the use of specific fibers and/or structures or the association of certain terms with specific fabric types. The structural category in which a publication is listed was determined by what a detailed study of text, illustrations, and references to related material showed the referent structure to be, rather than by the terms by which structures were identified in that publication.

INDEX

Page references for all classificatory headings and sub-headings, many of which are not specific fabric terms and do not necessarily appear in the index, will be found in the KEY TO THE CLASSIFICATION. Fabric names and the terms for specific fabric structures that are either discussed or mentioned in the text will be found in the index. This, it is hoped, will make it possible to find any description, discussion, or illustration in the volume that is applicable to a listed term.

Key to the Classification

PART ONE

Components of Fabric Structures 1

PART TWO

PART THREE

PART ONE

COMPONENTS OF FABRIC STRUCTURES

THE RAW MATERIALS of fabrics are fibers and filaments. They may be prepared in thread-like lengths and in that form interworked to form a fabric, or, if suitable, they may be converted directly into a fabric structure. But in either case they are the ultimate constituents of fabric structures, and if a description of a fabric is to be technically definitive, it must include identification of the fibers or filaments (*material content*) and the form (*structural make-up*) in which they enter into the structure of the fabric.

However, accurate identification of fibers is a technical determination requiring microscopic analysis and measurement as well as considerable special knowledge and experience in interpretation. The whole subject is treated in requisite detail in publications devoted to the study of the nature of the so-called 'textile fibers' and could not be adequately presented here. We therefore only outline (under the heading MATERIAL CONTENT) the main sources of the fibers and filaments which are suitable for conversion into fabrics and fabric elements, indicating the general classes of so-called 'textile fibers' and suggesting the varieties which may be encountered. Since the study of man-made filaments and fibers is a highly technical, constantly changing, and rapidly developing one, and since their use has entered so slightly into the study of ancient and 'primitive' fabrics on which this investigation of *primary structures* is largely based, only brief mention is made of their general types.

Inasmuch as the *structural make-up* of fabric elements is the result of mechanical manipulation of the raw materials, the physical details of the structure of a fabric element can be determined, with reasonable accuracy, by observation alone. We have tried, therefore, to provide some basis for determining and describing the make-up of the threads, yarns, cords, et cetera, which constitute the component parts or 'elements' of interworked fabric structures, distinguishing between fibers of limited length and filaments, and then indicating the various ways in which either may be put together to form useful elements for fabric construction.

PART ONE

Components of Fabric Structures

I MATERIAL CONTENT

A. Natural

1. Animal
2. Plant
3. Mineral

B. Man-made

SOURCES OF INFORMATION

II STRUCTURAL MAKE-UP

A. Continuous Filaments

1. Single
2. Combined
3. Twisted together

B. Fibers of Limited Length

1. Not spun
    a. Single
    b. Combined
    c. Twisted together
2. Spun
    a. Single
    b. Combined
    c. Plied
    d. Re-plied

Description and Measurement
Direction of twist
Tightness or angle of twist
Diameter

NOTES ON THE USE OF TERMS

Yarn • *Thread*
Single • *Single yarn* • *Single-ply yarn*
Plying • *Doubling* • *Re-plying* • *Re-doubling*
Rope-making terms

SOURCES OF INFORMATION

I MATERIAL CONTENT

Fibers and filaments are the ultimate constituents of fabrics. They come from many sources (both natural and man-made) and are variously treated and put together for use in fabrics.

A. NATURAL

Natural fibers, fibrous materials, and filaments are of animal, plant, or mineral origin.

1. ANIMAL

The animal kingdom provides material that can be utilized for fabric construction in the form of external fibers (e.g. *wool, hair, fur*), internal fibers (e.g. *sinew*), and secreted filaments (e.g. *silk*).

A. EXTERNAL FIBERS Skin products of sheep, goat, camel, rabbit, llama, alpaca, vicuña, buffalo, cow, horse, and similar animals, in the form of *wool, hair, fur*, et cetera, serve as components of fabric structure, as do human hair, feathers, and so on.

> NOTE: that strips of fur, rawhide, partially tanned skin, and leather, as well as cords wrapped with fur or feathers, are used as elements of fabric construction.

B. INTERNAL FIBERS *Sinew*, the fibrous connective tissue of animal tendons, provides thread-like elements suitable for various fabric uses with no processing except splitting or shredding, although it is sometimes broken up into shorter lengths and then spun as any short fibers would be.

C. SECRETED FILAMENTS The thread-like forms (filaments) secreted by caterpillars, mollusks, spiders, and so on, are known as *silk*. The 'true' silks are from the cocoons of the cultivated 'silkworm' (*Bombyx mori*), *wild silk*, from the cocoons of any of a number of similar 'silk moth' caterpillars which cannot be domesticated, and from communal larval nests. *Spider silk* is from the cocoons of spiders, *byssus* (*pinna*, or *sea-*) *silk*, from the byssus or 'beard' by which certain marine mollusks (*Pinna nobilis* and related varieties) attach themselves to the rock or sand floor of the sea.

2. PLANT

Available fibrous material that can be rendered useful for fabric construction is found in many parts of plant structures.

A. SEED AND FRUIT HAIRS The fibers and floss surrounding and attached to the seeds of certain trees and shrubs – notably *cotton*; also 'tree-cottons' (e.g. *kapok*) and so-called 'vegetable silks' like milkweed floss – can be utilized for fabric construction.

B. LEAF FIBERS Fibers from the leaves of monocotyledonous plants (e.g. *sisal, yucca, abaca, pineapple* – or *piña* – *banana, esparto*) are readily available.

C. BAST FIBERS The stem structures of dicotyledonous plants provide bast fibers – notably *flax* (linen); also jute, hemp, ramie, apocynum, nettle, et cetera.

> NOTE: that the term *inner bark* refers to bast (not bark) fiber – either to the extracted fibers or to sections of the interlaced networks of fibers that lie under the bark of certain trees and shrubs and can be utilized for *beaten bark-cloth* (see p. 20).

D. BARK AND ROOT FIBERS Some bark (e.g. *cedar*) provides fibrous material that can be shredded for use as fabric elements, and usable fiber is found in some root structures (e.g. *broom*).

E. MISCELLANEOUS From various plant sources come palm-leaf segments (e.g. *raffia*), nut-husk fibers (e.g. *coir*), stem-fibers from monocotyledonous plants (e.g. *Spanish* or *Southern moss*), pappus down and bristles, reeds, grasses, et cetera.

3. MINERAL

A. ASBESTOS *Asbestos* is the general term for any of several minerals having a fibrous structure. The fine crystalline fibers of some varieties have considerable luster and a high resistance to fire; they can be spun much as cotton or wool fibers are spun.

B. WORKED METALS Gold, silver, and other metals are used in the form of wire or flat metal ribbon (frequently wound round a core of another material) as elements of fabric construction and decoration. Metal is also used in the form of coins, disks, plates, beads, and so on, attached to fabrics as accessory objects (q.v.).

B. MAN-MADE

Mechanically extruded filaments are sometimes classified as either 'regenerated' or 'synthesized.' Those in the first group are further classified as being *protein-, cellulose-*, or *mineral-base*. The second group includes such filaments as *nylon*.

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II STRUCTURAL MAKE-UP

The *structural make-up* of the elements of fabric construction is the form given to the raw materials (fibers, fibrous matter, or filaments) which makes them suitable for use as fabric elements.

A. CONTINUOUS FILAMENTS

Natural filaments (animal in origin) are secreted, and man-made filaments are extruded, in continuous lengths.

> *Filament*: a thread-like form, that is, a long, fine, structurally continuous fiber — sometimes defined as 'a fiber characterized by extreme length.'

1. SINGLE

The term *single*, in reference to fabric elements, usually refers to the simplest usable unit. Silk filaments are secreted in pairs held together by gum sericin, the two together termed *bave*. The single silk filament (*brin*), or even the pair, is too fine and fragile to be used alone, so the term *single*, in reference to silk threads, usually denotes a group of from three to ten pairs of silk filaments whether twisted together or simply combined (see 2 and 3 below). The term *monofilament* is used to describe a single (man-made) filament of sufficient size to function as a yarn.

2. COMBINED

The process of combining two or more continuous filaments for use as a unit without twisting them together is sometimes described as 'doubling' (see p. 13).

3. TWISTED TOGETHER

The process of twisting together two or more filaments, or unit-groups of filaments, to form a twisted yarn is described as 'throwing.' (For the equivalent in *spun* yarns, see *plied yarn*, below.)

> NOTE: that even though combined and twisted together, neither fibers nor filaments are properly termed *spun* (v.i.) unless the process of *drawing-out*, by which short lengths are combined to produce a lengthened strand, is added to the twisting process.

B. FIBERS OF LIMITED LENGTH

Fibers – as opposed to filaments – are of naturally limited length, but filaments which have been broken up into shorter lengths are handled in the same way.

Fiber: a general term referring to the structural components of any animal or plant tissue, or fibrous material, used in the construction of fabrics.

1. NOT SPUN

Certain fibrous organic structures (fiber aggregates, fiber bundles, fibro-vascular bundles, etc.) are used in more or less natural form without being broken down to ultimate fiber length. They are split or shredded for fineness and sometimes knotted together for length.

A. SINGLE In the use of unspun fibers, the term *single* refers to a simple strand of fibrous material – which may or may not be twisted. Added length is achieved by knotting strands end to end. *Piña* (pineapple fiber) and *raffia* are familiar examples of single strands of fibrous material of limited length usually used untwisted and knotted for length. A *single* unspun strand which is *twisted* should be so described.

B. COMBINED Two or more single unspun strands of fibrous material that are used as a unit but are not twisted together (like continuous filaments used in the same way) can be described as 'combined.'

C. TWISTED TOGETHER The twisting together of two or more single strands of unspun fibrous material is the equivalent of *plying* – a term usually used in more specific reference to *spun* yarns (see below).

2. SPUN

Fibers of naturally limited length such as cotton and wool, as well as longer fibrous strands or filaments which have been broken up into short lengths (bast fiber bundles, silk waste, broken filaments, sinew), can be laid more or less parallel by carding or some similar process and then drawn out and *spun* to produce length, size, strength, and texture, as required.

Spinning: the process of twisting together and drawing out massed short fibers into a continuous strand.

A. SINGLE A *single yarn* (also referred to as *single-ply*, see p. 13) is the simplest continuous aggregate of spun fibers that is suitable for fabric construction.

Yarn: the general term for any assemblage of fibers or filaments which has been put together in a continuous strand suitable for weaving, knitting, and other fabric construction.

B. COMBINED A *combined yarn* is one composed of two or more *spun yarns* used as a unit but not twisted together. Qualifying terms such as *paired, triple,* and *multiple* can be used to describe combined yarns specifically.

C. PLIED A *plied yarn*, also called *ply-yarn* (rope-making term, *strand*), is formed by twisting together two or more *single yarns*. The number of single yarns thus united is indicated in the term for the plied yarn, as *2-ply, 3-ply*, et cetera. The process is termed *plying* (for use of the term *doubling* in this connection, see p. 13) and the direction of the *plying* is usually opposite to the direction of the spin of the single yarns employed (see DIRECTION OF TWIST, p. 11).

Twine: as a noun the term refers to a kind of *plied yarn*, usually constructed from medium twist single yarns plied in the direction opposite to that of the original spin.

D. RE-PLIED A *re-plied yarn* is a three-process construction formed by *re-plying* or twisting together two or more *plied yarns*, the direction of the twist usually opposite to that of the *plying* (as, for example, uniting with an S-twist two or more Z-plied, S-spun yarns).

Rope: a general term usually used to describe a *re-plied* construction of more than a given size (more than ½ inch in circumference according to some definitions). When three or more *ropes* are twisted together to form a still larger construction and each successive twist is in the direction opposite to the preceding twist (as, z-s-z-S), the result is usually called *cable-laid rope* (see discussion of *rope-making terms*, pp. 13 f.).

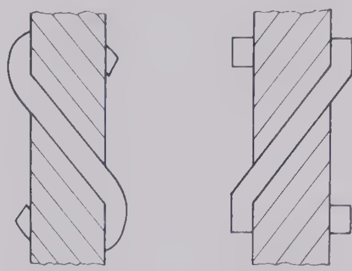
DESCRIPTION AND MEASUREMENT

No high degree of accuracy is possible in the measurement of yarns *in a fabric*. Their dimensions and appearance are affected by the way they function in the fabric structure and the way they have been used in its make-up. Their original characteristics may be correspondingly hidden or distorted. The twist may tend to loosen or tighten depending on the way the yarn is utilized so that the same yarn used in different ways, even in the same fabric, will not necessarily either appear the same or provide the same measurements. The direction of the twist may be emphasized by the nature of the weave, or it may be nearly obliterated; a plied yarn frequently appears to be single, the clear line of the plying twist lost in a close weave; and a raveled yarn retains the effect of the way it has lain in the fabric. However, if these possibilities are kept in mind and if it is clearly stated that given measurements are (or

are not) the measurements of a yarn *in the fabric*, even such approximate measurements as are possible can be extremely valuable and are, in fact, necessary for full description and comparison of fabric specimens.

In addition to the designation of fiber and type of make-up (outlined under MATERIAL CONTENT and STRUCTURAL MAKE-UP) adequate description and measurement of a fabric element should include notation of: *direction of twist, tightness* (or *angle*) *of twist*, and approximate *diameter* of the element and its component parts.

DIRECTION OF TWIST The *direction of twist* (rope-making term, *lay*) is designated S or Z according to whether the trend of the spiral of the spun or twisted element conforms, when held in a vertical position, to the slant of the central portion of the letter S or the letter Z (see Diagram 1); and, in print, the appropriate slanting lines (\ and /) are sometimes used in place of the letters to indicate the direction of the twist. (Lack of twist is usually designated *zero-twist*, although there seems to be merit in the suggestion that the use of the letter I would be more consistent with the use of S and Z.)



S-twist (\) Z-twist (/)
Diagram 1

The direction of the *final twist* of a yarn is a quite definite and determinable item of description which should always be recorded. In a *plied* or *re-plied* yarn the direction of the *original spin* may be more difficult to determine. Each successive twisting process usually reverses the direction of the preceding one, but this should not be taken for granted as there are many instances of plied yarns made up of single yarns which do not all have the same direction of spin, and of other exceptions to the rule of successive reverses of direction of twist.

TIGHTNESS OR ANGLE OF TWIST *Tightness of twist* is determined either by the so-called 'helix-angle' or by the number of twists per unit of lineal measurement – or both – and is designated by those measurements or by description based on estimates of such measurements. The term *angle of twist*, or *helix-angle*, refers to the angle that the slant of the twist makes with the vertical axis of the yarn (see Diagram 2). This is necessarily only an approximate measurement, especially in *single yarns*, but if some uniformity can be achieved in the use of terms to designate the general quality of spins or twists falling within a certain range of angle measurements, much useful comparative information can be recorded. Suggested

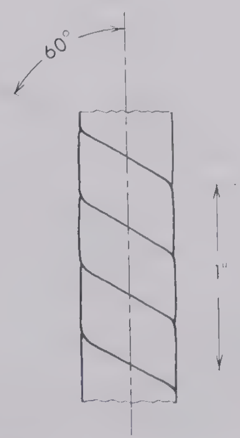


Diagram 2 Measurement of *angle of twist* and number of twists per unit of lineal measurement.

terms are: *loose* (spin or twist), up to 10°; *medium*, 10° to 25°; *tight*, 25° to 45° (see Diagram 3). A twist so tight that the yarn is inclined to retwist on itself when not under tension is generally referred to as a *crepe twist* since such yarn tends to produce a 'creped' or crepe-y effect in a fabric.

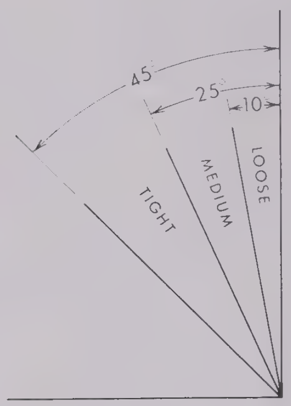


Diagram 3 Designation of *angle of twist*.

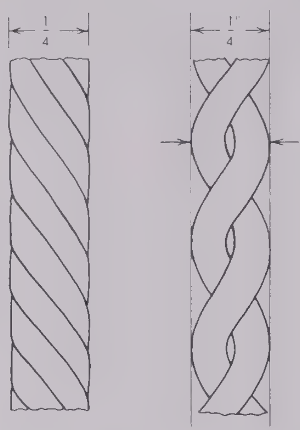


Diagram 4 Determination of 'over-all' *diameter* of yarn in cases of exaggerated 'waisting.'

DIAMETER Measurement of the approximate diameter of a *single yarn* is relatively simple. Even if the yarn is somewhat distorted by the weave or varies greatly from place to place, the diameter in any one place is easily measured — with reasonable accuracy. But *plied yarns* and *multiple-twist cords* may present greater difficulties. It is true that they usually show less variation from place to place and present generally smoother outlines than *single yarns*, but when they happen to be very loosely twisted or composed of somewhat wiry or stiff fibers, the continuity of the surface may be broken, making it difficult to determine what constitutes the *diameter*. In such cases the only reasonably definite measurement is the 'over-all' *diameter*, that is, the distance between two imaginary parallel lines tangent to the outer curves of the spiralling plies (see Diagram 4).

Notes on the Use of Terms

Yarn · Thread

Although the terms *yarn* and *thread* are frequently used interchangeably, certain differentiations of meaning are usually assumed and are borne out by a majority of definitions. The term *yarn* usually refers to a less highly processed element than the term *thread, thread* usually implying a finer as well as a more tightly twisted and 'finished' one; *yarn* is used to refer to single as well as to plied structures, *thread* usually only to plied; *yarn* is more commonly used in reference to materials for weaving and knitting, *thread* for sewing elements (or for specific uses of yarns, as in references to warp-threads, weft-threads, etc.). In general, *yarn* is the broader, more flexible term and adapts more readily to modi-

fying terms. Yarns may be described as tightly or loosely spun, as soft, hard, nubbly, creped, et cetera; whereas connotations of tightness and smoothness of twist cling rather persistently to the term *thread*.

Single · Single yarn · Single-ply yarn

These three terms all designate the simplest unit-structure suitable for fabric construction – weaving, knitting, et cetera. The meaning is not in question – only the relative adequacy and suitability of the terms. *Single yarn* is a clear and definitive term with which to designate an unplied and uncombined construction; but justification for the use of the term *single-ply yarn* rests on the way in which *ply* is defined. If a *ply* is defined as a 'unit of yarn' there is nothing contradictory in the term *single-ply yarn* as frequently used to emphasize a distinction between *single-* and 2-, 3-, or *multiple-ply* constructions, although there may be no real need for the more cumbersome term. If, however, *ply* is defined (as it most often is) as an 'individual yarn in a ply yarn' or as the 'number of yarns twisted together to form a ply yarn,' the propriety of the term *single-ply yarn* is perhaps more questionable. The use of the word *single* alone, as a noun, on the other hand, stops short of clear definition. Although it is in relatively common use, especially as a modern textile-industry term, and may occasionally be adequate even in less technical contexts, it will often lead to unnecessary confusion particularly in descriptions which involve both *plied* and *single yarns* used in pairs as well as singly. On the whole, the term *single yarn* seems preferable.

Plying · Doubling · Re-plying · Re-doubling

The term *doubling* has at least two distinct uses. In current textile-industry usage it is apparently practically synonymous with *plying* (curiously enough, not restricted to the plying together of *two* yarns) but it sometimes refers to the combining of several strands without twisting. In other fields, however, it has a more definitive use for which there is no other term, namely, to designate the process of actually *doubling* a spun or twisted yarn back on itself and allowing (or encouraging) the two sections to twist together – as they tend to do automatically, turning on each other in the direction opposite to their spin – to form a 2-ply yarn. This process is frequently used for primitive yarn and cordage production and may well have been the origin of *plying*. (The same principle is widely used in making fringes as well.) The process of twisting two or more *plied* yarns together is better described by the term *re-plying* than by 're-doubling' or 'cording.' Use of the term *fold* instead of *ply* is more common in Great Britain than in America.

Rope-making terms

From time to time various technical terms have been borrowed from the terminology of modern rope-making for descriptions of primitive 'cordage.' When, as frequently happens, similar (if not identical)

yarns and cords are found serving as elements of fabric construction, the same terms which were used to describe them as 'cordage' are applied to them in the fabric context. Soon the terms are being applied to all yarns in the fabric context, and as the usage is extended it becomes increasingly inappropriate. It may be entirely reasonable to expect that a worker in any of the extensive and varied fields of fabric study will have some familiarity with the special terminologies of other fields, including that of *rope-making* and *knot-work*, but substitution of special *rope-work* terms either for terms in general use in connection with fabrics, or for descriptive devices which are without special connotation, has little to recommend it as a means of communication of fabric information. The use of the term *rope*, for example, to describe the *re-plied* structure of a delicate yarn, would seem unnecessarily misleading even if we were justified in assuming general agreement on its special meaning in relation to yarn structure. But in *rope-work*, as elsewhere, there are differences of opinion about the exact meaning of terms; and while it is frequently argued that such terms as *cable-twist* and *hawser-twist* provide a simple means of designating specific sequences in the changes of direction of twist in yarns and cords, investigation indicates a lack of agreement among authorities on the exact implications of either term. We also find other sequences for which there are no specific terms. All in all, simple enumeration of the successive directions of twist found in each yarn or cord seems to provide more precise information and less opportunity for misinterpretation than the use of borrowed terms of doubtful relevance. A distinctive form of letter to designate the final — the visible — twist will add to the clarity and precision of the enumeration (e.g. z-S, s-s-Z, s-z-s-Z), although it is usually assumed (and always when the slanting line is used alone) that the final letter or symbol in any series designates the final (and visible) twist.

NOTE: that various useful graphic formulae have been worked out for accurate and brief notation of the total make-up of yarns and cords (see, for example, Bird, 1954, p. 18; Dixon, K. A., 1957, p. 135; Guidici, 1954, pp. 24-25; Pfister and Bellinger, 1945, p. 16).

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PART TWO

CLASSIFICATION OF THE STRUCTURES OF FABRICS

In classifying the structures of fabrics, a primary distinction must be made between structures which are composed directly from fibers or fibrous material (i.e. simply pressed and matted into coherence) and those in which the coherence necessary to a fabric has been systematically produced by an ordered *interworking* of previously prepared *elements*.

All fabric structures are, therefore, divided first into two main groups: those composed of *felted fibers*, and those composed of *interworked elements*. Felting, whether or not it preceded *interworking* in the development of fabric making as a whole, is basically simpler since it is a means of converting fibers or sections of fibrous material directly into a fabric. The process may on occasion be long and elaborate, but there are no distinguishable intervening stages between initial loose fiber or natural plant section and the final fabric. The fiber itself is the component of the fabric structure.

Interworked structures, on the other hand, no matter how simple, involve at least three stages: (1) loose fibers, or fibrous materials, which are composed into (2) elements, which are in turn interworked to form the (3) fabric. The fibers are the constituent parts of the elements; the elements, the constituent parts of the fabric. It is the order and the manner in which elements are interworked that provide the bases on which interworked structures are classified.

PART TWO

Classification of the Structures of Fabrics

I Felted Fibers
(see below)

I FELTED FIBERS

A. Natural Plant Forms

1. Beaten bark-cloth
2. Papyrus

B. Agglomerated Fibers

1. Felt
2. Paper

NOTES ON THE USE OF TERMS

Bark-cloth • *Bark cloth* • *Tapa*
Felt • *Woven felt* • *Felted weaves*
Felting • *Fulling*

SOURCES OF INFORMATION

I FELTED FIBERS

Certain fabric structures are composed directly from fibers – or from fibrous material. The qualities requisite to a fabric are achieved wholly or in part by *felting*, that is, by the application of pressure, heat, moisture, and so on.

To felt: to cause to adhere and mat together.

In terms of analysis of structure, *felted* fabrics are of two general types: 1) those composed from intact sections of natural plant forms that have an intrinsic coherence which is retained and utilized, in which the felting process serves mainly to soften, flatten, increase the native cohesion, and bond one section to another; and 2) those made from loose, dissociated fibers which are without initial coherence, in which the felting process is used to actually effect the fabric.

A. Natural Plant Forms

Natural plant forms of suitably interlaced fibrous structure (usually inner bark or bast) can, by means of soaking, beating, et cetera, be softened, flattened, felted, and smoothed into fabric form; and piece can be bonded to piece by the same process.

1. BEATEN BARK-CLOTH

Beaten bark-cloth is fashioned from sections of the inner bark of certain suitable trees and shrubs. The pieces of inner bark are soaked, sometimes boiled, to soften the fiber and then beaten or pounded into a flat coherent fabric. The length, breadth, and thickness of the finished fabric are not entirely dependent on the size of available strips of bark since, in addition to the extending effect of the beating or pounding, it is possible to bond separate pieces at their edges to increase the area, and layer to layer to increase the thickness. The combined soaking and beating, which results in crushing the succulent portions of the inner bark and felting the fiber structure, causes overlapping or superimposed pieces to adhere

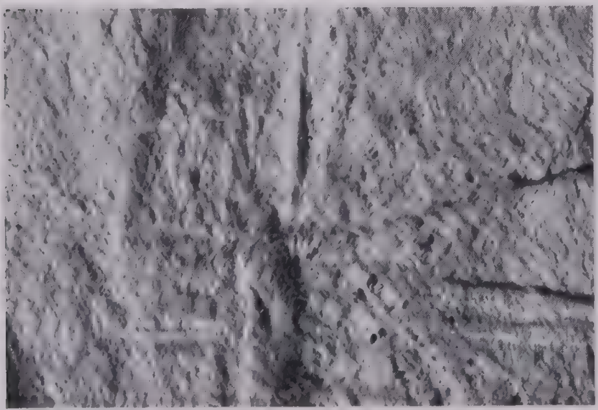

FIG. 1 *Beaten bark-cloth* – the surface texture.

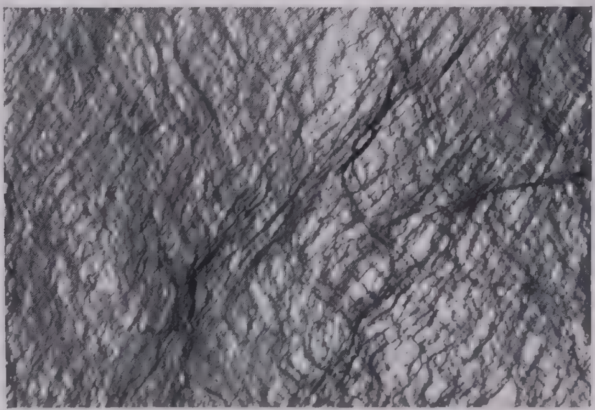

FIG. 2 *Beaten bark-cloth* – the fibrous structure.

to each other and makes the reinforcement of weak or thin spots as simple and practical as are the additions to size and thickness. In lieu of natural bonding, glue, paste, gum, or sewing may be used to attach the strips, layers, or patches.

The inner bark of trees and shrubs of the family *Moraceae* is especially suited to the production of *beaten bark-cloth* (fig. 1), due in part at least to the natural interlacing in the fibrous structure (fig. 2). The wild fig, the paper mulberry, and the breadfruit tree yield the inner barks which are probably most extensively used for *beaten bark-cloth*, that of the paper mulberry being said to produce the finest fabric and the whitest, in units which may measure 2 by 3 feet. From the trunk of the wild fig it is possible to secure pieces of bark more than 30 inches wide and as much as 20 feet in length before processing. By bonding piece to piece, the dimensions of a finished fabric can be almost indefinitely extended – some famous pieces of *tapa* cloth being reportedly 200 yards in length.

The making and use of *beaten bark-cloth* has a wide distribution through the tropical and sub-tropical regions of Africa, southeast Asia, the islands of the Pacific (Oceania), and the Americas. The processes employed differ locally only in detail, even when they are refined to the point of producing a fabric which approximates, and is frequently termed, *paper*. The implements, too, show remarkably little variation from place to place. Some of the beaters from widely separated areas are nearly identical; most are of stone or wood and almost invariably have at least one face which is ridged or grooved. But there is considerable diversity in the terms used in different areas to designate the finished fabric. Usually the local name for the tree or shrub from which the bark is obtained is also used to refer to the finished *bark-cloth*. The most familiar of these local names is *tapa*, which has become the generally accepted term for any or all of the *beaten bark-cloth* of Oceania. It has even been used (by extension of meaning) to distinguish *beaten bark-cloth*, no matter where made, from bark fabrics made of *interworked bark-fiber yarns*.

There are reports of narrow fabrics (belts, leg-wrappings, etc.) from northern Europe made of the bast of such trees as the lime, sycamore, and birch, but whether or not they are composed of *strips* of inner bark and whether or not there has been a *felting* of the fibers by soaking and beating is not made clear. Too few of the many references to the cedar-bark fabrics of the northwest coast of North America make it clear that they are of the interworked rather than of the felted variety. On the other hand, there are specific reports of the use of strips of *unbeaten* bark in New Guinea and of beating and felting as a way of finishing *interworked* bark-fiber fabrics to add softness and flexibility.

2. PAPYRUS

Papyrus is a laminated paper-like fabric composed of the cellular pith that lies within the rind of the reed *Cyperus papyrus* (native to the region of the Upper Nile), long known as the 'paper reed.'

The general principle, or concept of production, of *papyrus* is very similar to that of bark-cloth. Each is basically a transformation of one or more plant sections directly into a flattened *felted* fabric. In making *papyrus*, after removal of the outer rind of the reed, lengths of the remaining pith are either cut into longitudinal sections or (according to other accounts) soaked and then beaten into flat strips. Either method would result in strips which, all accounts agree, are laid side by side (contiguous, but not overlapping as in *bark-cloth*) and covered with another similar layer, the strips lying at right angles to those of the first layer. The two layers are soaked, beaten, and thus felted together; hammered smooth, dried, and finally polished to form a surface suitable for writing. To add to the length, sheets can be *pasted* together but there is no record of bonding as in *bark-cloth*.

The most familiar use of the stem section of the reed is for writing material. Accounts of the use of *papyrus* for sails, mats, sandals, 'cloth,' et cetera, often do not disclose whether these fabric forms were of the same hammered, felted structure as the writing material or were made by quite different manipulations of the substance of the papyrus reed.

B. Agglomerated Fibers

Loose, that is, structurally unconnected or disconnected, fibers can be massed, mixed, consolidated, and flattened into a coherent fabric structure.

1. FELT

A mass of fibers lying indiscriminately in all directions (fig. 3), not spun or twisted into yarn, and not *interworked* in any regular order, can be made to cohere sufficiently to form a firm fabric by the application of certain mechanical (and occasionally chemical) processes involving moisture, heat, pressure, friction, et cetera.

In contrast to *bark-cloth* and *papyrus*, in which the natural fibrous structure of the plant is more or less retained to form the basic fibrous structure of the fabric, *felt* is composed of a mass of loose animal fibers (wool, hair, or fur) in more or less haphazard arrangement. Wool fibers have a scaly surface structure which gives them, more than other fibers, a tendency to cling firmly to each other when subjected to the manipulations of the felting process.

Felt was known and used in ancient times in much of Asia and Europe but was not developed to any significant extent in aboriginal America or Africa. Felt-making may well have originated among the nomadic tribes of Central Asia, where it undoubtedly antedated the use of wool for spinning and weaving. The methods used today by the Asiatic peoples who still make *felt* probably differ very little from those used by the early nomadic tribes.

The most commonly reported procedure involves, first, spreading the wool in an even layer on a mat (or piece of felt) and moistening it, then, rolling it up in the mat, kneading and pounding it as it is rolled. With continued kneading, pounding, and moistening, it is repeatedly unrolled and rerolled, from first one end and then the other for a matter of hours, and in this way the *felting* of the fibers is gradually effected. Some reports mention the use of hot water; some, the addition of grease and oil for sizing; others refer to preliminary scouring of the wool to remove natural grease and oil; but otherwise there seems to be little variation except in the making of *felt carpets* by treading wool which has been spread in a shallow trench of the desired size. Whatever the method, colored wool (or pieces of felt) arranged on the surface in a desired pattern can be incorporated into the fabric simply by continuation of whatever felting process is being used.

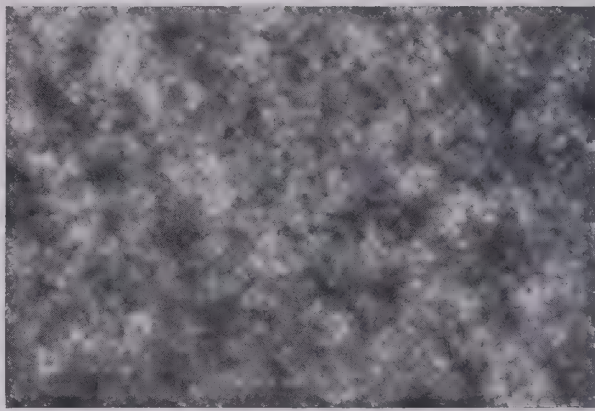

FIG. 3 *Felt* – the structure.

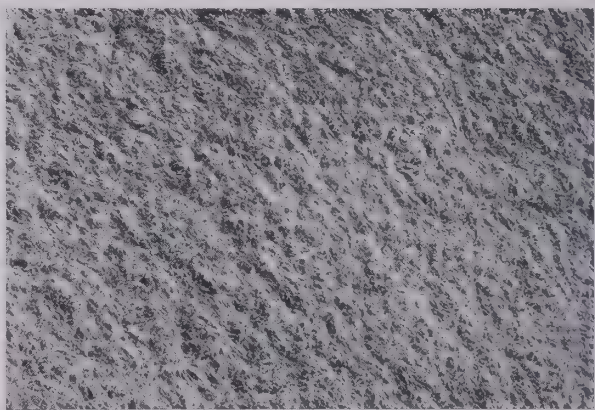

FIG. 4 *Felt* – the surface texture.

NOTE: that the use and effect of *felting* as a *finish process* may make a woven or knitted fabric hard to distinguish from actual *felt*. Subjecting woven or knitted woolen fabrics to treatment similar to that used to compact loose wool fibers into a coherent *felt* is somewhat loosely termed *felting*, but as a finish process it is more precisely designated *fulling*. The use of moisture, heat, pressure, and friction tends to shrink and thicken the fabric, obscuring the structure of interworked elements and

producing a felt-like surface texture (fig. 6) almost indistinguishable from that of true *felt* (fig. 4). Held up to a strong light, however, the underlying structure may still be visible (fig. 5). Such fabrics should be differentiated from actual *felt* and are best described as *felted*, with the basic structures named if ascertainable, as, for example, *felted plain weave* (fig. 5), *felted 2/2 twill*, *felted knitting*.

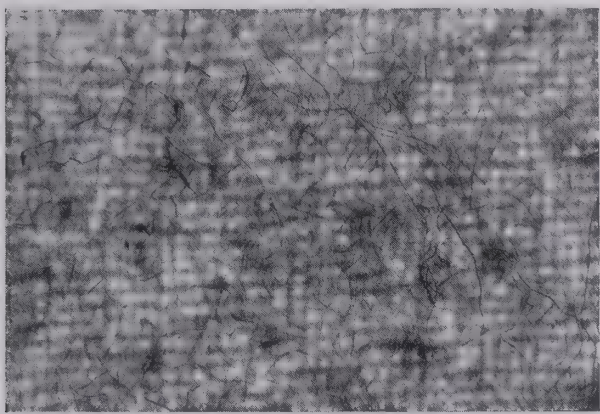

FIG. 5 *Felted plain weave* – the structure.

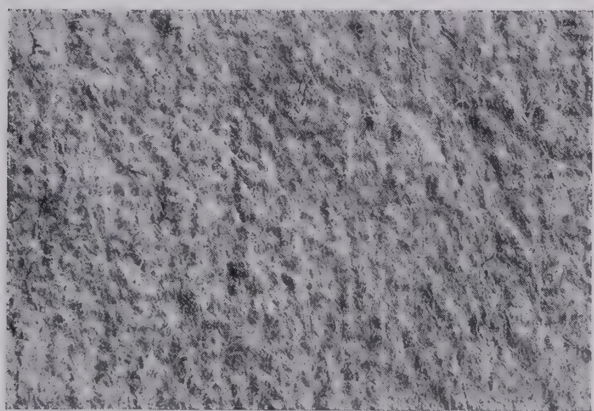

FIG. 6 *Felted plain weave* – the surface texture.

NOTE: that there is also a finish process known as *beetling*, in which moisture and a hammering action are used to flatten the threads and consolidate ('close') the weave of linen (and sometimes of cotton) cloth.

2. PAPER

Paper is essentially a *felted* web of short units of cellulose fiber. The separate processes and particular types of mechanical equipment used in paper-making differ widely. They vary partly according to the nature of the fibrous material being used and the qualities of weight and finish desired. There are, however, certain fundamental operations which are always involved, such as: cutting and compression of the fibers in water to produce a pulpy mass; spreading of the pulp in a thin, even layer; draining to remove superfluous water; finishing; and drying.

The similarity of the structural principle of *paper* to that of *felt* is obvious. Each is, in essence, a flattened web of enmeshed fibers. The relationship is emphasized by the consistent use of the word *felt* in descriptions of paper-making processes, as in references to 'removal of the felt from the mold' or to 'fibers becoming felted together.' *Felt* has substantially the same structure as *paper* but differs greatly in outward characteristics and general use as well as in fiber content. On the other hand, *bark-cloth*, differing much more in structural make-up, may sometimes so nearly approximate the qualities and outward characteristics of *paper* and serve so many of the same purposes that it is not infrequently referred to as *paper*.

Notes on the Use of Terms

Bark-cloth · *Bark cloth* · *Tapa*

The fact that there are two radically different ways of using bark (or inner bark) for fabric construction is well recognized, but the importance of distinguishing clearly between the two types of resulting fabric structure goes largely unheeded. The terms *bark-cloth* and *bark cloth* are both used for the beaten felted type already discussed and many readers assume that the words (hyphenated or not) invariably refer to the beaten felted product. At the same time, it seems natural to use the term *bark cloth* to distinguish fabrics woven or constructed of *bark-fiber yarns* from those whose yarns are of cotton or some other fiber. How, then, to differentiate one type of bark fabric from the other? The use of the term *tapa*

for this purpose is of questionable value because of its geographical connotation and a tendency to associate it specifically with the use of paper mulberry bark. It is so useful a term in its widely accepted sense of 'the beaten bark-cloth of Oceania' that there seems little reason to try to stretch it to cover more. It is conceivable, of course, that unvarying use of the hyphenated form, *bark-cloth*, to refer to the type of fabric which retains much of the original fibrous structure of the inner bark, and of the separate words, *bark cloth*, to denote the type made of *bark-fiber yarns*, would eliminate misunderstanding – but only if that usage were widely and strictly adhered to. For the present, the best way to forestall any chance of misconstruction would probably be to use definitive wording such as *beaten bark-cloth, bark cloth* (twined), *bark cloth* (twill woven), in addition to discriminating use of the hyphen, in any description, reference, or discussion involving fabrics made of bark.

Felt · Woven felt · Felted weaves

The distinction between *felt* and a fabric finished in such a way that it resembles felt has been discussed and illustrated on pages 22 and 23. Such terms as *woven felt* and *knitted felt* are frequently used to designate fabrics which are felt-like in finish but not in actual structure, and it is possible that they convey, fairly adequately, the idea that the fabrics referred to are not true felt. It seems, however, that the term *felted* used in conjunction with identification of the specific type of interworked structure (e.g. *felted plain weave, felted knitting*) is more precisely descriptive of a knitted or woven fabric which has undergone a treatment (*fulling* or *felting*) by means of which something of the surface texture and appearance of true *felt* has been imparted to it; and that it would, therefore, be more practical to reserve the term *felt* for specific designation of a 'massed-fiber' fabric. Adherence to this usage has the further advantage of precluding inadvertent suggestion of a fabric in which strips of real *felt* have been employed as weaving or knitting *elements*.

Felting · Fulling

Although these two terms are often used interchangeably – and defined in some glossaries as synonymous – their meanings are differentiated in dictionary definitions and in precise usage. Since a clear and accepted distinction of meaning between two terms always augments the possibility of accurate and precise description, it seems unreasonable to discard or to disregard admissible differences of meaning or implication. *Felting*, as already noted, refers to the processes which cause fibers to mat together and adhere; whereas *fulling* implies an already existing fabric, since it refers to such actions as shrinking and thickening of cloth. Such references are not applicable to the making of *felt* which has no pre-existent area to decrease (shrink) and which involves flattening rather than thickening of the layer of massed fibers. *Fulling* is accompanied by some *felting* of the fibers in the yarns of the fabric. *Felting* is not necessarily accompanied by any of the shrinking and thickening effects which are typical of *fulling*.

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II INTERWORKED ELEMENTS

A relatively small percentage of the fabrics of the world owe their structural coherence to the *felting* process. In the majority, separate *elements* (each with its own *structural make-up*) are systematically interworked to form a coherent material. The particular nature and order of the *interworking* is what distinguishes one such fabric structure from another, and consequently classification of the structures rests on classification of the *systems of interworking*. For this it is necessary, first, to determine the number of *elements* or *sets of elements* on which each system is based.

> *Element:* a component part or unit of the structure of an *interworked* fabric. The term refers to yarn, thread, strand, cord, thong, or whatever natural or contrived unit of fibers or filaments is *interworked* to form a fabric.
>
> *Set of elements:* a group of such components all used in a like manner, that is, functionally undifferentiated and trending in the same direction. Whenever certain elements are differentiated from others in the same fabric, either in the direction they take or by the purpose they serve in the structure, they constitute a separate *set of elements.*

Classified on the basis of the number of *elements* or *sets of elements* that are interworked, fabric structures fall into four main categories: *single-element, two-single-element, one-set-of-element,* and *two-or-more-sets-of-element* structures. A *single-element* structure is made up of a single continuous element interworked with itself; a *two-single-element* structure, of two functionally distinct elements, the passages of one interworked and secured by 'stitches' of the other. In *one-set-of-element* structures a minimum of three functionally undifferentiated elements have a common directional trend and are interworked with each other; while in *two-or-more-sets-of-element* structures there is a basic minimum of two sets (*warp* and *weft*) which differ from each other in the direction they take in the fabric. The last named category is large and immensely varied, comprising all fabric structures in which transverse (or *weft*) elements are interworked with longitudinal (or *warp*) elements, including those in which there are additional *sets of elements* differentiated either directionally from the two basic sets or functionally from one of the basic sets having the same direction.

The minimum equipment and preliminary processes required before elements can be interworked to form a fabric varies with the number of elements or sets thereof. For *single-element* and *two-single-element* structures it is only necessary that the elements be suitable, or suitably prepared; whereas before the elements of a single *set* are interworked, they must be secured at at least one end and are usually arranged as a set, in parallel series. With *two or more sets of elements,* in order to interwork the elements of a transverse set (the *weft*) with those of a longitudinal set (the *warp*), the longitudinal set needs both an ordered arrangement and a certain amount of stability, usually achieved by means of tension. There are many devices for maintaining the arranged order of the *warp elements,* for controlling tension, for selective manipulation, and so on; and there are numerous ways of effecting, controlling, and expediting the interworking of the *weft.* There is, however, no immutable relationship between the complexity of either the processes that precede fabric construction or the equipment used and the complexity of the fabric. Given sufficient time and skill, the most complex structures and designs can be produced with the simplest of equipment.

PART TWO

Classification of the Structures of Fabrics

I Felted Fibers

II Interworked Elements

A. Single Element
(*see below*)

A. SINGLE ELEMENT

1. Linking
   Variation: *link-and-twist*
2. Looping
   a. Simple loops
      Variation: *loop-and-twist*
      Variation: *cross-knit loops*
   b. Interconnected loops
      1). Single
      2). Double
   c. Knotted loops
      1). Suspended knots
         Simple knot
         Slip-knot
         Knotted buttonhole loop
         Clove hitch
         Cow hitch
      2). Fixed knots
         Square knot
         Granny knot
         Sheet bend
         Fishnet knot
3. Interlooping
   a. Vertical (*knitting*)
      Variation: *crossed knitting*
   b. Vertical and lateral (*crochet*)

NOTES ON THE USE OF TERMS

Linking • *Looping*
Coiling • *Looping*
Simple looping • *Buttonhole stitch* • *Half hitch*
Netting • *Knotless netting*
Terms for knots
Cross-knit looping • *Needleknitting* • *Knit-stem stitch*

SOURCES OF INFORMATION

A. Single Element

A fabric structure can be built up by the repeated interworking of a single continuous element with itself. The structure is based on the formation of rows (or courses) of 'stitches' of varying types and degrees of complexity, into which successive rows are worked. It is classified according to the type of connection that the element makes with the previous row. The element is used in one of two ways: either it is the *free end* and the full length of the element that is drawn through the appropriate opening, or a *loop* of that part of it closest to the working edge of the fabric. The active use of the *free end* is exemplified by the various forms of *linking* and *looping*; the drawing of a loop through a loop, by *interlooping* (e.g. knitting and crochet). The *free-end* process is closely related to sewing (whether or not a needle or shuttle is used); many of the same structures are found in sewing (*accessory stitches*, q.v.); and the terms for equivalent sewing and embroidery 'stitches' are frequently used to describe the structures of *linked* and *looped* fabrics. The *free-end* process definitely limits the length of yarn or cord that can be conveniently handled; *interlooping* (a loop through a loop) does not – although if no implement is required for preparation of the element, the disadvantage of working with a limited length is readily overcome by tying or spinning additional fiber on to the *free end* as the work progresses.

It is possible to develop any of the *single-element* fabric structures in either of two ways: *spirally* (i.e. round and round) to form cone-shaped, tube-shaped, or flat circular fabrics; or back and forth in the same plane to produce square, rectangular, or otherwise shaped fabrics. A certain amount of elasticity is characteristic of any fabric fashioned from a *single element*.

1. LINKING

In *simple linking* (fig. 7) successive rows of running 'open loops' are formed by a stitch like that known in sewing as *overcasting* or *whipping* (p. 236). Each row is formed by a progressive spiralling of the element round the portions between the stitches of the previous row. The relationship of parts is like that of 'linking arms' (rope-work term, *elbow*). The meshes tend to be elongated and the openings may be barely perceptible unless the fabric is spread (as in figs. 7 and 8) or the element is stiff enough to retain the openings. The two faces are *identical.*

VARIATION: *Link-and-twist*

The *link* is made firmer by the addition of a *twist*, that is, by taking a complete turn (two overcasting stitches or a 'round turn') round the element in the previous row (fig. 8). Added twists can be used to vary the size as well as the firmness of the meshes. The direction of the twist is *identical* on the two faces, as is the structure of the stitch.

FIG. 7 *Simple linking.*

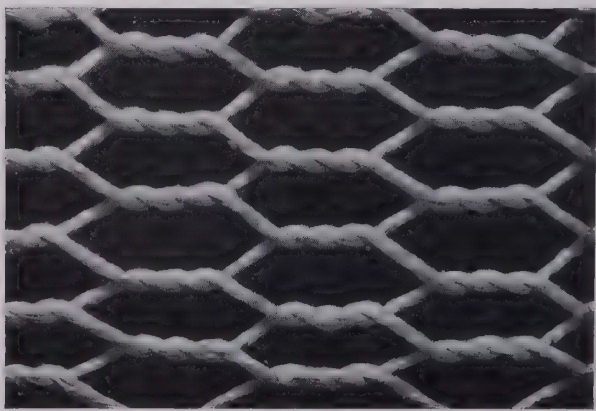

FIG. 8 *Link-and-twist* (or twisted link).

NOTE: that the structures produced row after row by *one continuous element* in *linked* fabrics are identical with those developed vertically by means of a *set of elements* in *interlinking* (p. 60). Unless ends and edges of the fabric are intact, it may be impossible to determine the process of construction from the evidence of the specimen.

2. LOOPING

A complete *loop* is formed (and will be retained in the fabric) if the element crosses over itself as it moves on to form the next loop.

> *Loop:* a doubling of a cord or thread back on itself so as to leave an opening between the parts through which another cord or thread may pass.

A. SIMPLE LOOPS

Simple looping is built up by means of the stitch on which most of the *looped stitches* used in sewing, netting, and lace-making are based. The stitch is known in sewing and in lace-making as *buttonhole stitch,* in rope-work as *half hitch.* Of the countless terms used in one context or another to designate the resulting fabric structure, *simple looping* is the most widely used, *buttonhole looping,* fairly common.

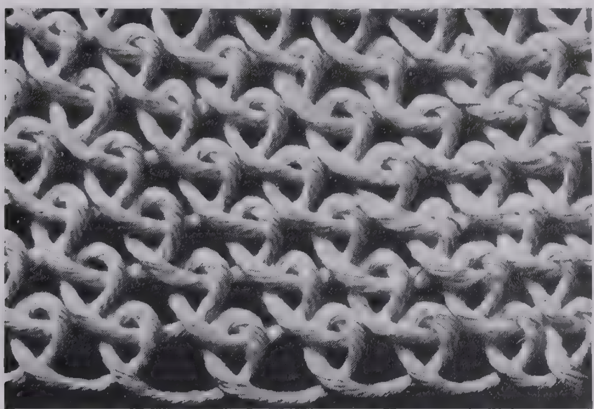

FIG. 9 *Simple looping* (or *buttonhole looping*) crossed left-over-right.

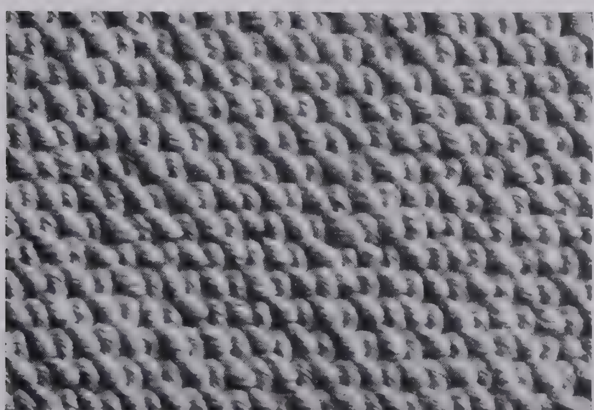

FIG. 10 *Simple looping* (or *buttonhole looping*) crossed left-over-right, close-worked.

The use of the structure is so widespread chronologically and geographically that it is hardly an exaggeration to call it universal, and it ranges in application all the way from heavy rope fender covering and sturdy carrying nets to delicate, decorative laces. It is the basic stitch of the *needlepoint laces*; it is used extensively for loose net-like structures (fig. 9) and for firm, close-worked, cloth-like fabrics (fig. 10). Its use in association with a *foundation element* is discussed and illustrated on page 53; as an *accessory stitch* in 'detached embroidery,' on page 242.

NOTE: that figures 9 and 10 show a left-over-right crossing of the element which produces an up-to-the-left diagonal in the close-worked fabric. The opposite crossing produces the opposite diagonal. The structure of the stitch, the crossing of the element, and the direction of the diagonal are *identical* on the two faces of the fabric.

VARIATION: *Loop-and-twist*

The mesh is somewhat elongated and the stitch made firmer when the *simple loop* is elaborated by the addition of one (fig. 11) or more turns of the element about itself. This is usually referred to as *loop-and-twist* (if there is more than one twist the number can be stated), occasionally as *twisted loop* or *twisted buttonhole stitch,* or differentiated as having a 'full turn.' In lace-making it has a variety of other names. It is seldom used for close-worked fabrics; there is no marked diagonal; the two faces of the fabric are *identical.*

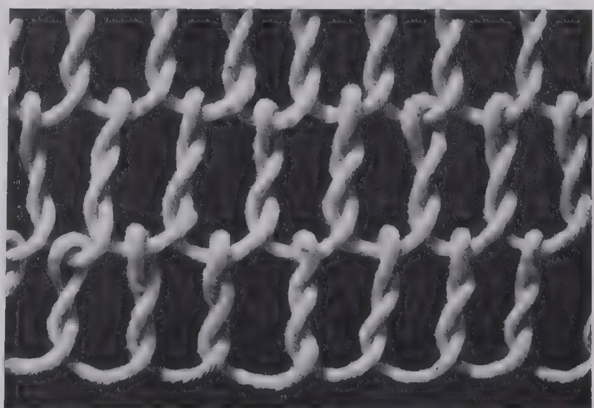

FIG. 11 *Loop-and-twist,* crossed right-over-left.

VARIATION: *Cross-knit loops*

Cross-knit looping differs from *simple (buttonhole) looping* chiefly in the fact that the loop is taken round the crossing of a loop in the previous row (figs. 12 and 13) rather than over the lag between loops (fig. 9, p. 31). This means that the loops, instead of alternating in position in successive rows and thus developing the diagonal wales noted in close-worked *simple looping*, are aligned vertically and produce marked vertical ribbing on one face of the fabric whether close-worked (fig. 14) or not (fig. 12). The two faces of *cross-knit looping* are *dissimilar*, the reverse distinguished by the horizontal portions of the loops (figs. 13 and 15).

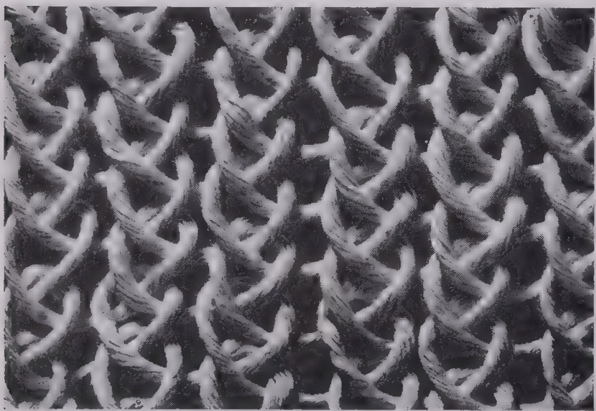

FIG. 12 *Cross-knit looping* (face).

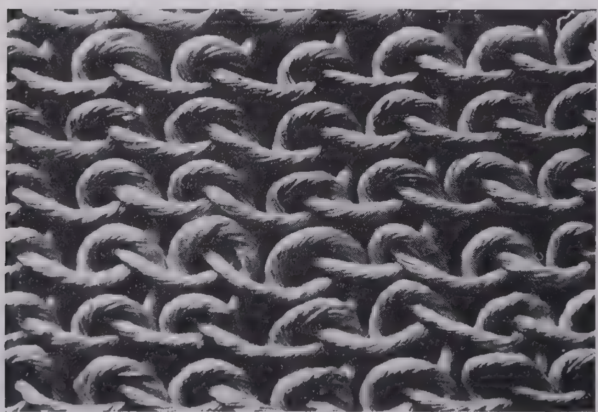

FIG. 13 *Cross-knit looping* (reverse).

The effect which is characteristic of the face of *cross-knit looping* is such that the fabric is sometimes described as 'chained' or 'braided,' but it is more often and more accurately identified with the appearance of *crossed knitting* (see pp. 41 f.). Although the methods of construction are quite different (all knitting is *interlooping*), the resulting structures are frequently identical and there is seldom anything in the fabric to determine which process has been used. The same structure is also found in embroidery (see p. 243).

Related *single-element* structures also characterized by the vertical alignment of stitches include those in which the element passes through rather than round the stitch directly above it (this is sometimes designated *pierced*) and those in which the stitch is taken through or round the one in the second or third row above, or to the right or left. None of these variants seems to have been very extensively used and they are usually described rather than named.

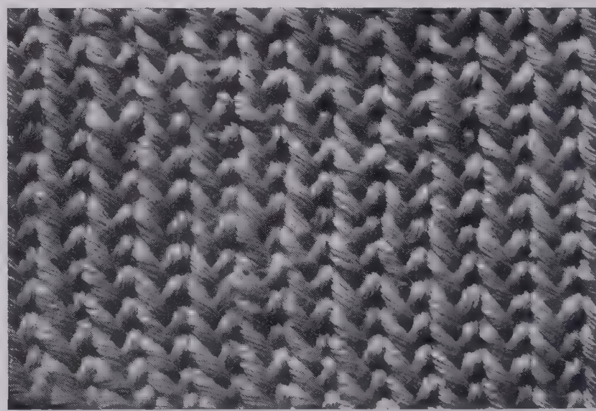

FIG. 14 *Cross-knit looping*, worked close (face).

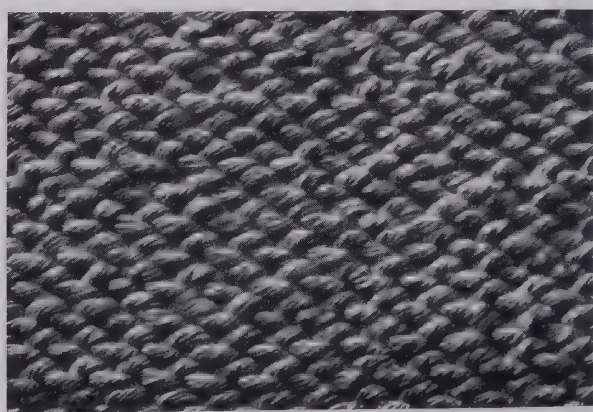

FIG. 15 *Cross-knit looping*, worked close (reverse).

NOTE: that the closing of the loop may be left-over-right as illustrated here, or right-over-left. The direction of the crossing should be noted in descriptions of the structure, although the assumption that it proves anything about the way the looping was constructed seems to be unjustified.

B. INTERCONNECTED LOOPS

A fabric of *interconnected looping* is one in which the loops are linked not only with those in the previous and succeeding rows, but also laterally with loops in the same row.

1. SINGLE

The simplest form of *single interconnected looping* differs from *simple (buttonhole) looping* only in the lateral linking with adjacent loops in the same row (fig. 16). It may be open, as shown here, or close-worked, and the two faces of the fabric are *identical.*

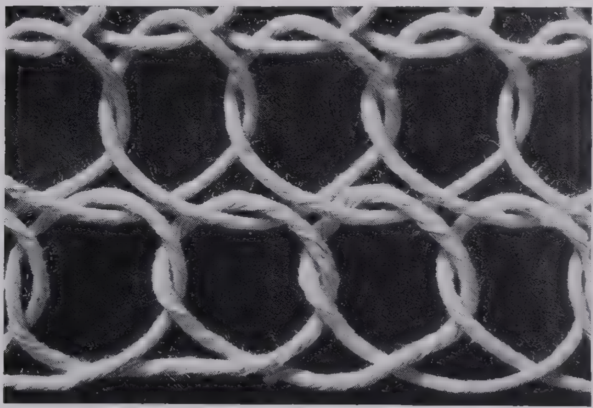

FIG. 16 *Single interconnected looping.*

Variation usually takes the form of lateral extension and overlapping of loops so that they link not with adjacent but with more distant loops, and sometimes interlace with intervening ones. This type of variation is sometimes described as *imbricated,* and the Scandinavian mitten-making technique known as *Vantsöm* is one form of it.

2. DOUBLE

The contour of the numeral 8 pictures the general form of a *double loop.* A fabric made up of rows of loops formed like a progressing connected series of figure-8's may be classified as *double interconnected looping.* The element, carried down and around in a clockwise direction, then back up and around counterclockwise (or vice versa), is linked with all adjacent loops (fig. 17). Although frequently identified by reference to the 'hourglass' shape, this type is more often called *figure-8 looping.* When close-worked or stretched vertically, the parallel slanting crossings are compacted and emphasized, and the mesh is not apparent. If not linked with laterally adjacent loops, the 8-shaped *double loop* slips into a simple *loop-and-twist.* The two faces of the fabric are *identical.*

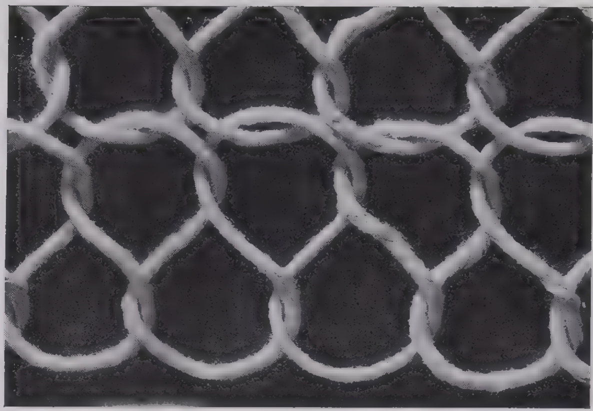

FIG. 17 *Double interconnected looping, figure-8* (or 'hourglass').

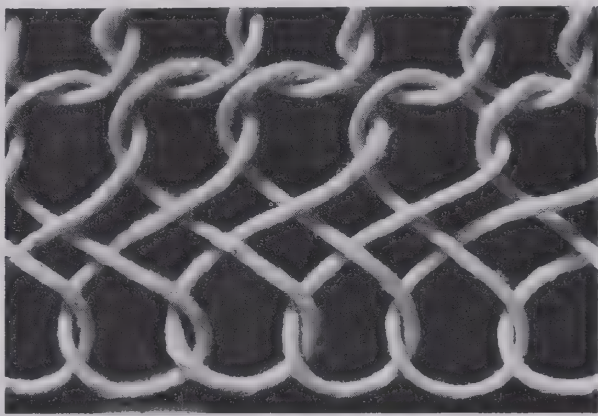

FIG. 18 *Figure-8 looping* (overlapping and interlaced).

Variation, as in the case of *single interconnected loops,* tends to take the form of lateral overlapping with over-and-under interlacing (fig. 18). Notation of the order of the interlacing is useful in comparing or contrasting specimens that appear similar and in describing specific examples.

Other types of variation (not illustrated) include the addition of twists to the lateral linking; elongating the mesh; and increasing the distance and varying the interworking between the upper and lower loops of the 8.

Double, or *figure-8, looping* is much more widely used than the single interconnected forms. Innumerable varieties and elaborations have been perfected and are extensively used for complete fabric structures and also in conjunction with other forms of *looping* and *linking* for patterning, varying, and edging.

C. KNOTTED LOOPS

Knotted looping is a single-element looped structure in which the loops are secured by knots. It is sometimes described as *looped and tied.*

> *Knot:* a tie or fastening achieved by a tightened interworking of the parts of one or more cords or threads (usually characterized by some protuberance).

Probably the most familiar and prevalent embodiment of the principle of *knotted looping* is to be found in the fabrics known as *knotted netting* (fishing nets, ancient hair nets, filet lace, and many others), although the structure is also found in close-worked fabrics in which the knots are contiguous, and in mixed (close and open) textures such as those produced by *tatting.* The principle and the essential structure are the same whether close-worked or open but it is in the open form, *netting,* that the main difference between *knotted looping* and the *knotless* varieties of looping already discussed is exploited. The addition of the securing *knot* makes it possible to construct single-element fabrics with meshes of fixed dimensions and almost any size desired.

Since the structural varieties of knotted fabrics, and especially of knotted nets, are identified primarily by the type of knot used, it is the structures of the knots themselves that must concern us here. Innumerable knots with diverse uses have been recorded, variously defined, and named, but only those known or thought to have been used to construct *knotted fabrics* are pertinent to this discussion.

When a knot is used to form and secure a mesh, it involves both the active, or working, part of the element as it makes the new knot and the pendent section between two knots in the previous row. If a tie (*hitch*) commonly used to secure a cord or thread *round* something is used in net-making, the pendent loop serves only as a passive element over which the knot may be said to be hung, and the knot will move slightly along the element from which it is *suspended.* Knots of this type will be discussed under the heading SUSPENDED KNOTS. On the other hand, a knot (*bend*) which is capable of uniting the ends of two cords or threads necessarily engages both segments more or less equally, and when such a knot is used as a mesh knot the pendent loop becomes actively engaged in the knotting. These will be discussed under the heading FIXED KNOTS.

1. SUSPENDED KNOTS

SIMPLE KNOT As already noted the knots classified as *suspended* are to a certain extent movable; the pendent loop is not actively engaged. The simplest form of knot used to secure one thread or cord *round* another is of this type. A list of terms used to designate the 'simplest knot' includes *simple knot, single knot, half knot, overhand knot, half hitch, thumb knot,* and *lake-dwellers' (lake-dwelling* or *lacustrine) knot*; but there seems to be no correlation between the different terms and the variations in the form of the knot.

Usually the actual structure of a knot cannot be determined without loosening the tie enough to disclose the order of the over and under interlacings. Although the interlacings cannot be changed in the loosening, the original 'set' of the knot may be lost. In figure 19 it is easy to recognize the look of an *overhand* knot tied by the active element, while figure 20 shows what appears to be a *half hitch* or *simple loop* taken by the active element round its own part.

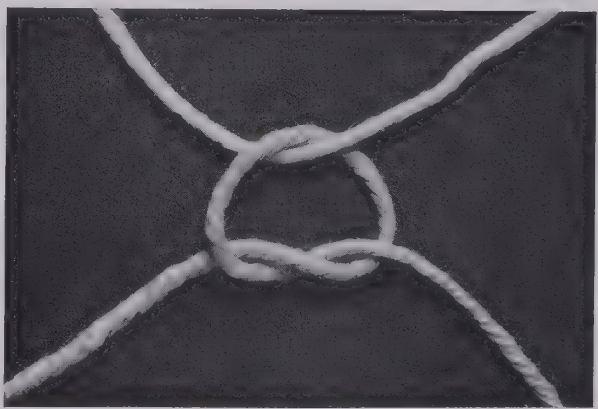

FIG. 19 *Simple knot : overhand.*

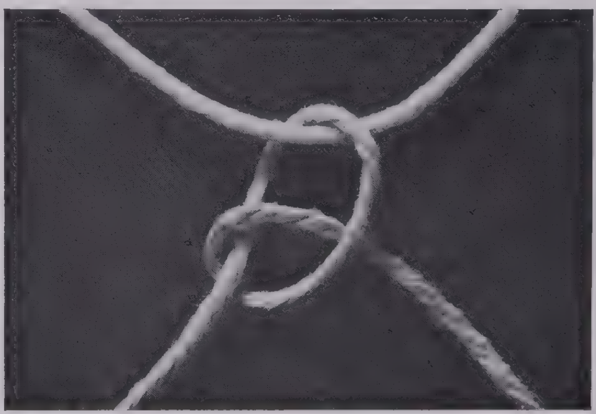

FIG. 20 *Simple knot : overhand* (half hitch appearance).

The conformation differs but the interlacing is the same, and the essential similarity of structure is easily demonstrated by flopping the long right-hand loop to be seen in figure 20 over to the left and noting how the knot loses the look of a *half hitch* and takes on the *overhand* appearance of figure 19.

On the other hand, figures 21 and 22 show obverse and reverse of a knot which is easily mistaken for the one in figure 20 but which, having a consistent over-1-under-1 interlacing, cannot be converted in the same way. It follows, then, that if we are going to distinguish a *half hitch* type of *simple knot* from an *overhand* type, the one designated *half hitch* should be the one which will not convert (in a fabric) into the *overhand* type. The need for words with which to distinguish between the two is demonstrated by the not infrequent use of the term *lake-dwellers' knot* to identify a specific knot structure when both types are to be found diagrammed under that name.

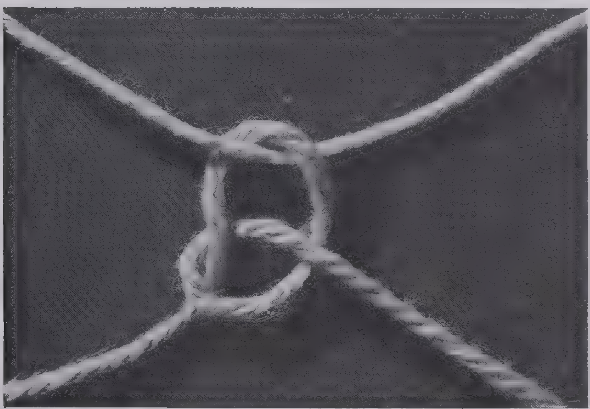

FIG. 21 *Simple knot : half hitch* (face, if worked under the loop from the left; opposite face of fig. 22).

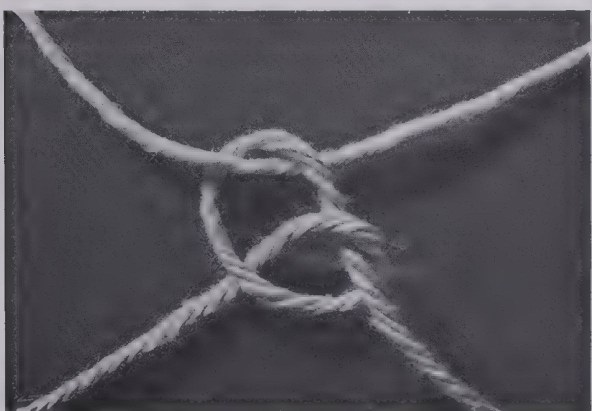

FIG. 22 *Simple knot : half hitch* (face, if worked over the loop from the right; opposite face of fig. 21).

Realization of the fact that the *overhand* type is *identical* on the two faces if set as in figure 19, but *dissimilar* if set as in figure 20, may help to assure retention of the original set of the knot when loosening it. The *half hitch* type always has *dissimilar* faces and all types of the *simple knot* are *asymmetrical.*

NOTE: that knots used for knotted fabrics can be started *from either left or right*, and *either under the mesh loop or over.* These variations will not necessarily be either illustrated or mentioned but their possibility should be borne in mind because it means that neither the direction of the work nor the 'right' or 'wrong' side of the fabric can be determined from the evidence of the knot structure alone. It should also be noted that although, as a general rule, a knotted fabric worked 'round and round' will show the same face of the knot in successive rows, while one worked 'back and forth' will show opposite faces, many knots can be worked from the opposite direction in such a way as to show the same face.

SLIP-KNOT *Slip-knot* is a term often used merely to indicate a knot that is in some way movable, but when used to identify a specific knot structure, it should denote the type diagrammed in figure 23, a type also described as a *loop and overhand knot.* In net- and fabric-making it may be intended to function as a sliding, or *suspended*, knot or it may be the unintended result of failure to fully engage the pendent loop in tying a *sheet bend* (p. 38). But in either case, as long as it is utilized as a mesh knot it lacks the characteristic by which it is sometimes defined and from which it may have been named, that is, immediate reduction by pulling the end (cord *a*, fig. 23). The knot is *asymmetrical*, the two faces *dissimilar.*

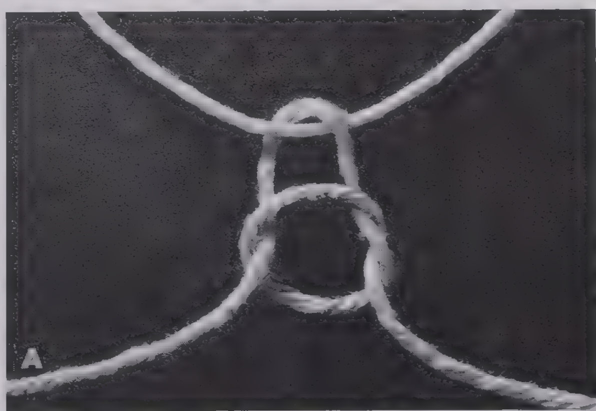

FIG. 23 *Slip-knot*, or *loop and overhand knot.*

KNOTTED BUTTONHOLE LOOP A *knotted buttonhole loop* (which might also be called a *knotted half hitch*) is composed of a *simple (buttonhole) loop*, or half hitch, with a second *simple loop*, or half hitch, taken round the base of the first and tightened. The second *simple loop* is the tie or securing part of the knot and fixes the length of the suspension loop. Tightening the knot close to the element from which it is suspended (i.e. shortening the suspension loop as much as possible) makes a firm fabric but a somewhat bulky tie and the knot is more often used with some exaggeration of the length of the suspension loop. Sometimes carelessly referred to as a *slip-knot*, it is also described as an 'overhand knot around a simple loop.' It may be the structure referred to when only the general term *knotted looping* is used and as an *accessory stitch* (q.v.) it may be described as *knotted buttonhole filling*. The knot is *asymmetrical* and the two faces are *dissimilar* (figs. 24 and 25).

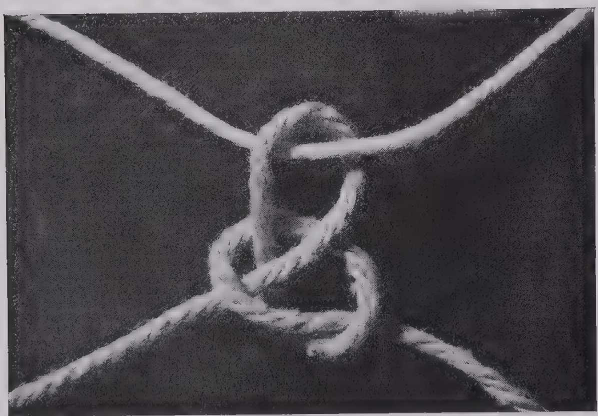

FIG. 24 *Knotted buttonhole loop.*

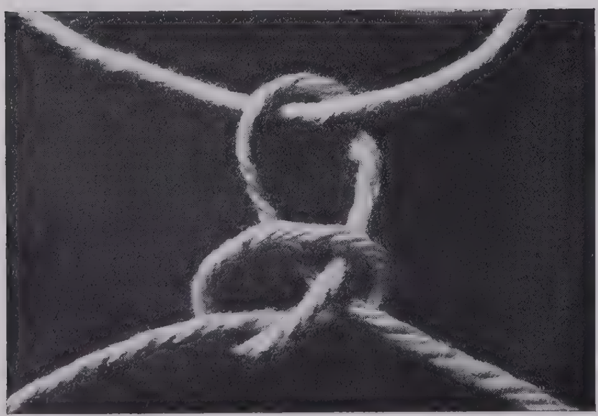

FIG. 25 *Knotted buttonhole loop* (opposite face of fig. 24).

FIG. 26 *Clove hitch*, or *two half hitches.*

CLOVE HITCH A *clove hitch* (fig. 26) differs from the suspended knots discussed so far in having two 'stitches' taken over the pendent loop. Composed of two identical contiguous *simple loops* (*buttonhole loops*, or *half hitches*), it is frequently considered an unknotted rather than a knotted structure and is variously referred to as *double simple looping, double Brussels stitch, double buttonhole stitch*, or *two half hitches*, depending on the context. Nevertheless, the two 'stitches' taken close together tighten and hold sufficiently to act as a knot; the *clove hitch* is usually classified as a knot and netting made with it as a knotted netting. It is *asymmetrical*, the two faces *identical.*

COW HITCH A *cow hitch*, or *lark's head knot*, like the *clove hitch*, is composed of two contiguous *simple loops*, or *half hitches*, over the same mesh loop. In the *clove hitch* the loops are identical and face in in the same direction. In the *cow hitch* (figs. 27 and 28) they face in opposite directions, making the knot a *symmetrical* one with *dissimilar* faces.

In some types of rope-work this structure is called *reversed half hitches*, but its status as a knot seems unquestioned and descriptions of it seldom emphasize the unknotted loops of which it is composed. It is used for the starting row of many fringe and knotted mesh constructions, as well as for knotted mesh itself. It is the basic knot of the circles and picots of *tatting* (where it is known as the 'whole' or 'double' stitch, and the *simple loop* as the 'half' or 'single' stitch). In knotted fabrics, the *cow hitch* differs from the *square knot* (figs. 29 and 30) only in the way it is set, and either knot, if loosely tied, is easily converted into the other.

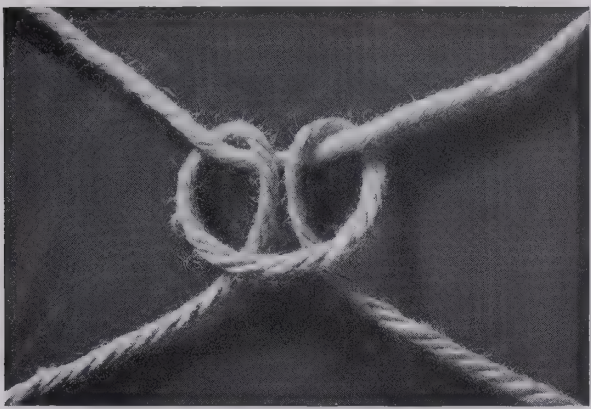

FIG. 27 *Cow hitch*, or *lark's head knot*.

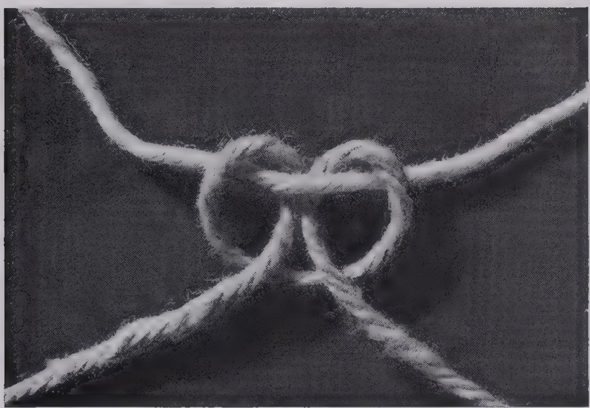

FIG. 28 Opposite face of fig. 27.

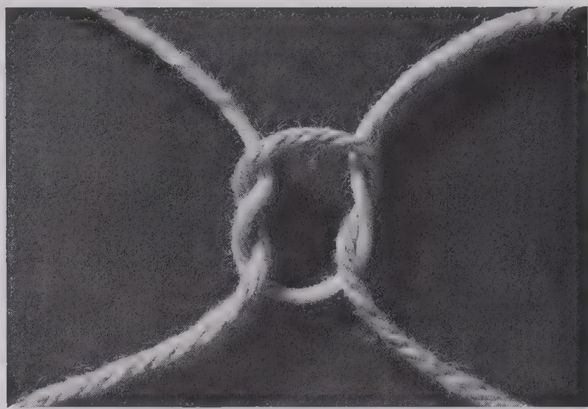

FIG. 29 *Square*, or *reef*, *knot*.

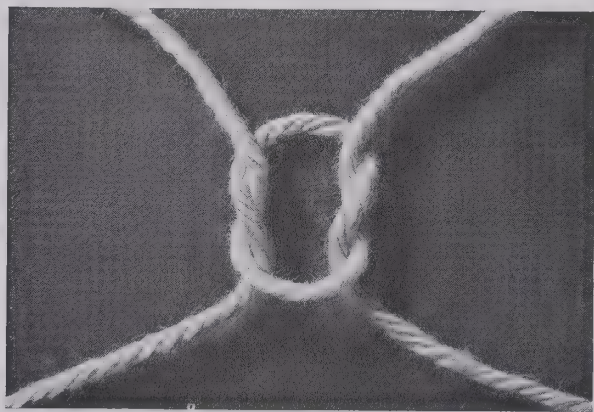

FIG. 30 Opposite face of fig. 29.

2. FIXED KNOTS

In knotted fabrics, *fixed* knots (as distinguished from *suspended* knots) are those in which both the pendent loop and the active portion of the element are engaged in the knotting action.

SQUARE KNOT A *square knot*, or *reef knot*, differs from a *cow hitch* in being set in such a way that the pendent loop plays an active part in the knotting (figs. 29 and 30), making it a *fixed* instead of a *suspended* knot. When used in netting, it is sometimes called a *flat knot*, sometimes described more specifically as a *vertical reef knot*, and has been explained as 'a *cow hitch* capsized into a *reef* or *square knot*.' When used to knot the net ground of 'filet lace,' it has been called the *Chinese filet knot*, as distinguished from the *European filet knot* (presumably the *sheet bend*, q.v.), although neither the actual nor the documentary basis for the geographical distinction is clear. The *square*, or *reef*, *knot* is symmetrical, the two faces *identical*.

GRANNY KNOT The *granny knot* is sometimes described as a *vertical granny knot* when it is used for netting. I have diagrammed it (fig. 31) as I have found it in actual specimens of netting although I have found no published diagrams which show it in this familiar form. The knot is *asymmetrical*, the two faces *identical*.

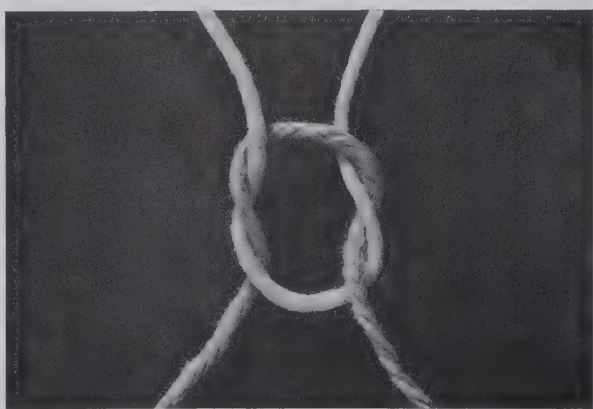

FIG. 31 *Vertical granny knot*.

SHEET BEND The *sheet bend* (or *weaver's knot*) is so widely used for knotted netting that it is often referred to as the *ordinary netting knot*, the *ordinary mesh knot*, or simply as the *mesh knot*. Apparently all its possible variations are made use of (i.e. started from the left as in fig. 32, or from the right, from under the mesh loop, as in the same figure, or over it). The terms used to describe such details are so completely lacking in standardization that an accurate diagram provides the only exact identification of a particular specimen. The essential features of a *sheet bend* can be seen in figures 32 and 33 which show obverse and reverse of a common form of it. The *sheet bend* is frequently identified with the 'filet knot' (the 'European' as distinguished from the 'Chinese') but the knot found in most filet lace is not the *sheet bend* but the *fishnet knot*. As already noted (p. 35), the *sheet bend* will fall off into a *slip-knot* if the pendent loop is not fully engaged. The knot is *asymmetrical* with *dissimilar* faces.

FISHNET KNOT The *fishnet knot* exists only as a mesh or netting knot. If it is used to join the free ends of two cords, the relative positions of points *a*, *b*, *c*, and *d* (fig. 34) will not be fixed, *a* and *b* will shift positions as the knot is tightened, and the result will be a *sheet bend*. In netting, however, the relative positions of *a*, *b*, *c*, and *d* are fixed, and the *fishnet knot* retains its identity. It is easily identified if the element used is relatively stiff, but if the element is pliant, tightening the knot may cause the engaged loop to turn over and cross (fig. 35) and render the knot indistinguishable from a *sheet bend* until it is loosened to reveal the cross. This may explain why the *fishnet knot* is so seldom distinguished from the *sheet bend* and identified as a distinct structure, and also why both are identified with the 'filet knot.' Although unnoted in the modern literature of knots and rope-work, the *fishnet knot* is found in many meshed fabrics from ancient and more recent 'primitive' cultures.

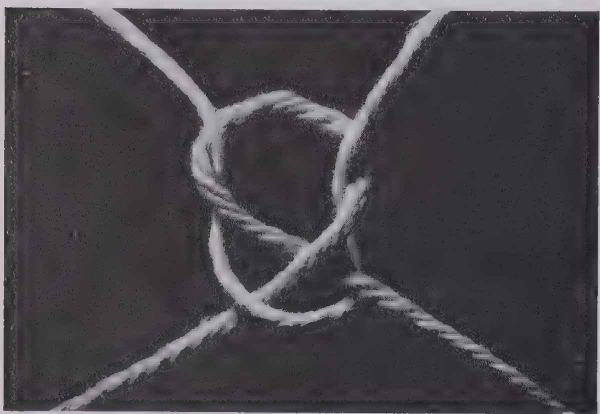

FIG. 32 *Sheet bend* (or *weaver's knot*) – started from the left, from under the mesh loop.

FIG. 33 *Sheet bend* (or *weaver's knot*) – opposite face of fig. 32.

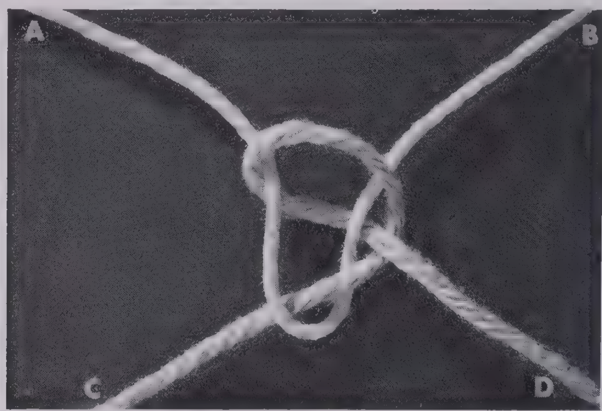

FIG. 34 *Fishnet knot*, started from the left, from under the mesh loop.

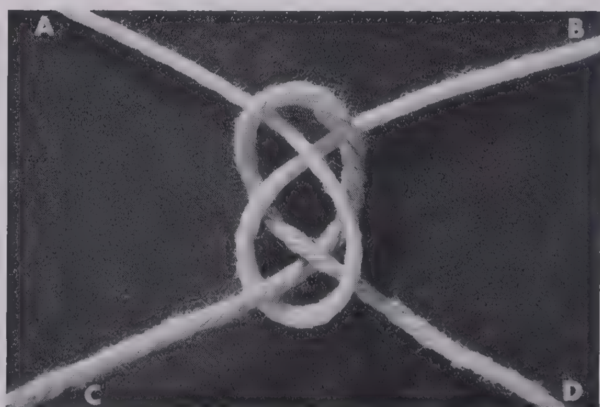

FIG. 35 Same knot as in fig. 34 with the mesh loop turned over.

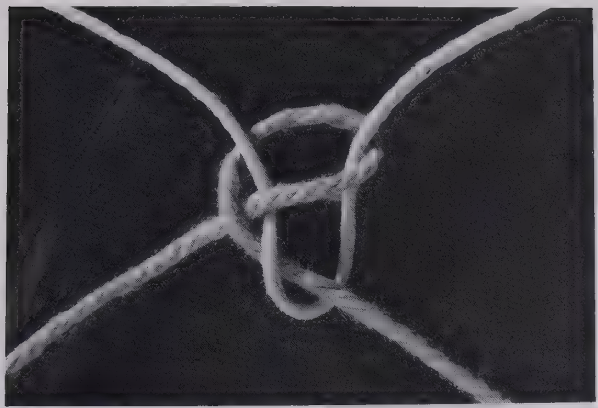

FIG. 36 *Fishnet knot* – opposite face of fig. 34.

FIG. 37 Same knot as fig. 36, with the mesh loop turned over (opposite face of fig. 35).

The *fishnet knot* has all the possibilities of variation noted for the *sheet bend*, but if the mesh loop is turned over and crossed within the knot, the actual 'starting' direction (from left, or right, over, or under the loop) will not be evident in the finished knot. The knot is *asymmetrical*, the faces are *dissimilar*.

NOTE: that many books on needlework (particularly of the late 19th century) give directions for making 'netting' or 'filet.' The knot itself is seldom named, and it is usually the way of making it that is illustrated, not the knot itself. However, when the knot is diagrammed it usually proves to be the *fishnet knot*; and if directions and diagrams for making the 'netting' are followed, it is almost invariably the *fishnet knot* which results. There seems, therefore, to be some justification for the conclusion that in European (and American) needlecraft of the late 19th century the *filet knot* was the *fishnet knot*. But the assumption that the term *filet knot* always refers to the knot we have diagrammed in figures 34 and 36 is not justified as long as 'the filet knot' is so often identified as the *sheet bend* and 'the Chinese filet knot' as the *square* or *reef knot*. There are also unidentified knots (some quite different from recognized netting knots) used for what are probably local varieties of the square meshed net or lace which is generally (although perhaps too loosely) referred to as *filet*. Unless or until *filet* is defined in terms of the use of a specific knot, the term *filet knot* will be most useful as a term not intended to indicate anything about the actual structure of a knot, but only that it is a knot used to make the mesh ground of filet lace.

3. INTERLOOPING

Interlooped fabrics are those which consist of loops of a single continuous element drawn through other loops already formed by the same element. Since the portion of the element nearest the working edge of the fabric is used to form each new loop, the entire length of the element does not have to be drawn through the previous loop and consequently the length of the element is not limited, as it is in *linking* and *looping*, to what can be conveniently carried in a shuttle or needle. This characteristic gives rise to the use of the expression *endless thread* to designate the *interlooped* type of structure.

Knitting and *crochet* represent the two major types of *interlooping*. In *knitting* the interlooping is *vertical* and the loops are vertically aligned, each loop securing the corresponding one in the previous row. *Crochet* is characterized by both *vertical* and *lateral* interworking of loops, and each new loop (or the series of loops constituting the new stitch) secures the one before it in the same row.

In both *linked* and *looped* structures, each loop (or stitch) is completed and secured as it is made. Pulling the active element will only tighten the structure, and any edge is a finished edge. In contrast, each loop (or stitch) of an *interlooped* structure is secured only when another has been worked through it, and pulling the active element will unravel the fabric stitch by stitch. Neither *linked* nor *looped* structures require any variation of structure to secure or finish an edge; *interlooped* structures do. In *crochet*, at least one securing stitch is required; in *knitting*, a row of securing stitches.

A. VERTICAL INTERLOOPING (*Knitting*)

Knitting in its simplest form consists of successive rows of 'running' open loops, each loop engaging the corresponding one in the previous row and being in turn engaged by the corresponding one in the following row (figs. 38, 40, 41). The alignment of loops and their interconnection is *vertical*; and if one loop is released, the previous loops in the same vertical 'wale' will be released one after the other, although none in the same horizontal row will be affected.

The work may progress either round and round or back and forth. All the loops in one row are maintained on needles or sticks and worked off one at a time as new loops are formed on other needles. Thus at any given point in the construction all the loops of the working edge of the fabric are secured only by the implements being used.

In *plain knitting* all the loops in any one row are on the same face of the fabric. If the rows alternate so that the loops are on one face in one row and on the opposite face in the next (fig. 38), the two faces will be *identical* in both structure and appearance. Both will be rough, and the horizontal ridges formed by the rows of loops will be more noticeable than the vertical alignment of the 'wales.' This structure is usually identified as *garter stitch*, although it is not so much the stitch itself which is referred to as the relationship of the stitches in one row to those in another.

Stocking stitch is the corresponding term used to describe the *plain-knit* structure when all the loops are on one face of the fabric and the two faces are *dissimilar*. One face has a smooth surface with an appearance of vertical chaining (fig. 39) which emphasizes the *vertical* alignment of the *interlooping*, while the reverse has a rough surface with the horizontal rows of loops emphasized (fig. 42). Although the term *stockinet stitch* is sometimes used instead of

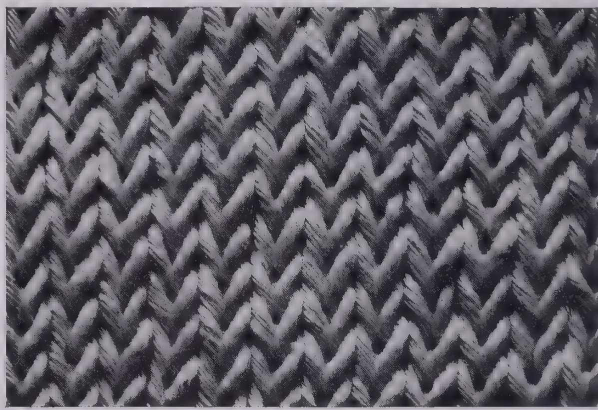

FIG. 39 *Plain knitting*, 'stocking stitch'.

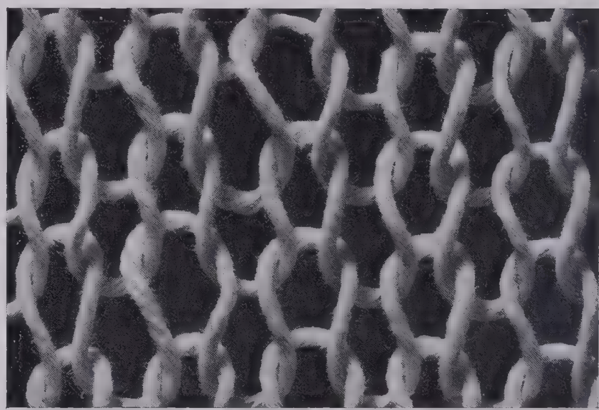

FIG. 40 Loosely worked construction of fig. 39.

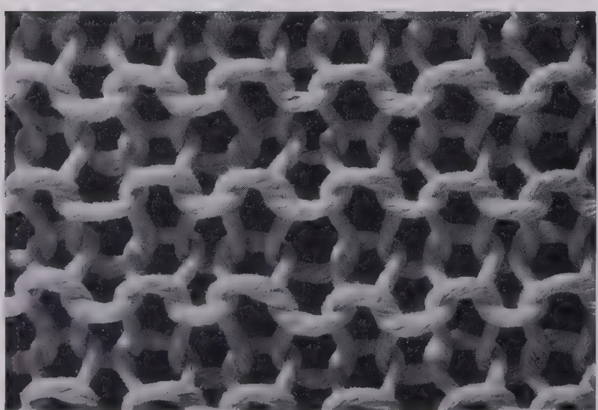

FIG. 38 *Plain knitting*, 'garter stitch.' (The two faces are *identical*).

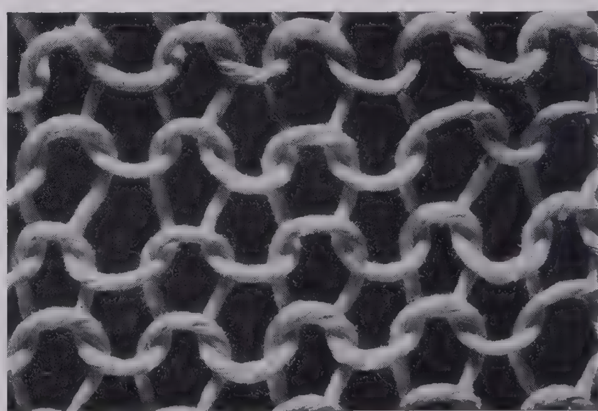

FIG. 41 Loosely worked construction of fig. 42 (opposite face of fig. 40).

stocking stitch, the term *stockinet* more often refers to a fabric worked in *stocking stitch*.

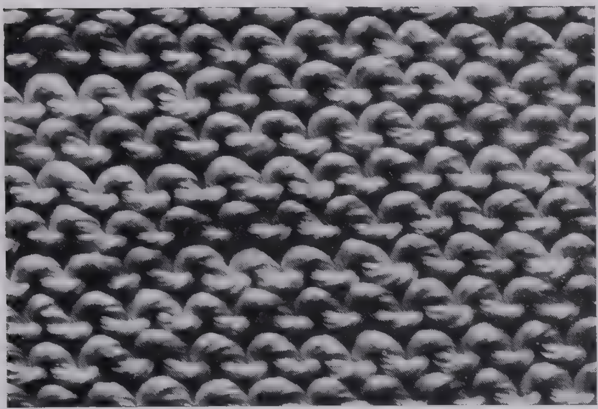

FIG. 42 *Plain knitting*, 'stocking stitch' (opposite face of fig. 39).

NOTE: that although associated with the 'rough' surface of 'stocking stitch' fabrics, the terms *purl* and *purling* are essentially terms of construction. They indicate the way the loop is made – or the stitch taken – in relation to the implements being used. They do not describe anything about the actual structure of the fabric.

> *To purl:* to invert the stitches in knitting; to knit with inversion of the stitches.

The terms *knit* and *knitting*, on the other hand, are used in two distinct ways. As generic terms, they can be used to describe either a construction process or a type of structure, but when used in a more specific sense they refer (like *purl* and *purling*) to a manner of making, that is, to construction only. In other words, the terms *knit* and *knitting* can be used to specifically designate the use of the *plain stitch* taken in the ordinary way as contrasted with the use of the 'inverted' stitch taken in the manner referred to as *purling*. For example, the structure shown in figure 38 would be described as *plain knit* or *plain knitting*. If found in a flat fabric constructed by knitting back and forth, reversing the fabric for each successive row without varying the way of taking the stitch, the whole process would be described as *knitting*. But if the same structure were found in a tubular fabric made by knitting round and round, 'inverting' the stitch in alternate rows, the process would be described as *knitting* one row and *purling* the next. The nature of the *interlooping* – the structure of the fabric – would be the same in both instances.

VARIATION: *Crossed knitting*

Crossed knitting is quite commonly said to be the oldest form of knitting. The loops are not the 'running' open loops of knitting as we know it best today (figs. 38-42) but are taken with a half turn which forms a cross in each loop (figs. 43-48). The left side (or leg) of the loop may be crossed over the right, as illustrated here, or the right over the left; but the direction of the crossing is *identical* on the two faces of the fabric.

Crossed knitting can, of course, be used both for the 'garter stitch' type of structure with loops on opposite faces of the fabric in alternate rows, and for the 'stocking stitch' type with all the loops on the same face of the fabric. In 'garter stitch' both faces are rough surfaced and horizontally ridged (figs. 43 and 44), and if the rows are very close and compact the crossing of the loops may be obscured. The two faces of the fabric are *identical*.

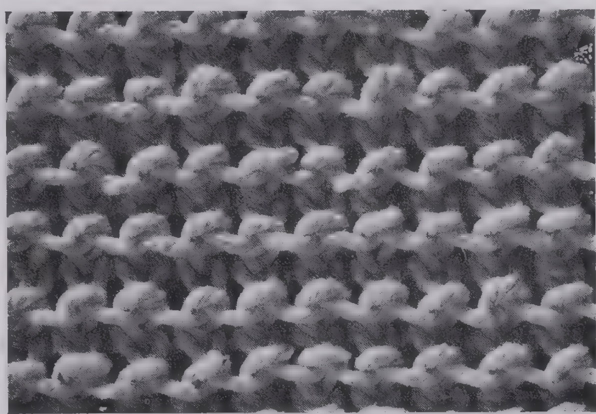

FIG. 43 *Crossed knitting* (left-over-right), 'garter stitch.' (The two faces are *identical*.)

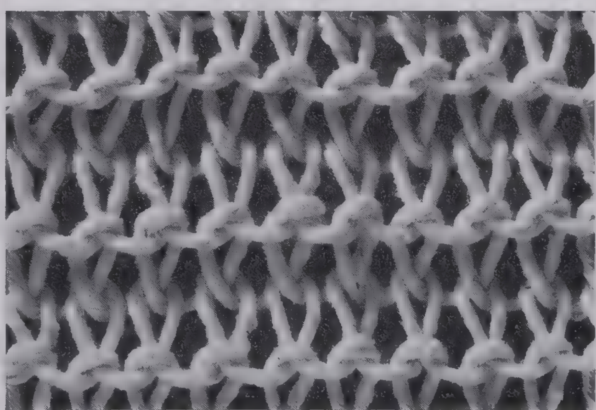

FIG. 44 Loosely worked construction of fig. 43.

NOTE: that the designation of the direction of the crossing of one 'leg' of a loop over the other in *looped* or *interlooped* structures is based solely on the visual aspect of the structure. The loop is viewed, as illustrated and as usually worked, with the curve at the top, the right 'leg' forming the right side of the loop, the left 'leg,' the left side.

When *crossed knitting* is done in the 'stocking stitch' manner, with all the loops on one face of the fabric, that face will, of course, be rough surfaced (fig. 47), and the horizontal rows of loops will be at least as evident as the vertical alignment. The other face will be smooth (fig. 45), and the *vertical* alignment of the *interlooping* will be clearly marked. Although the crossing of the loops is usually quite evident on the smooth face, it can easily go unnoticed on the rough surface composed wholly of loops. If the fabric is closely and compactly worked, the slight slant of the concave loops may be the only indication that the knitting is *crossed*. The two faces of the fabric are *dissimilar*, but the direction of the crossing of the loops is the same on both.

NOTE: that the 'stocking stitch' form of *crossed knitting* is structurally identical with the type of *looping* we have called *cross-knit* (p. 32). This raises the question of the possibility of determining the process by which the earliest examples of the structure were produced. The theory that *crossed knitting* preceded uncrossed knitting in the development of *interlooping* rests partly on the assumption that certain early specimens are examples of *interlooping* with two or more needles, not of *looping* with an eyed needle. But even complete specimens (and many ancient ones are fragmentary) offer little reliable evidence of the process of fabrication. An unfinished fabric with associated implements would probably be necessary for positive determination.

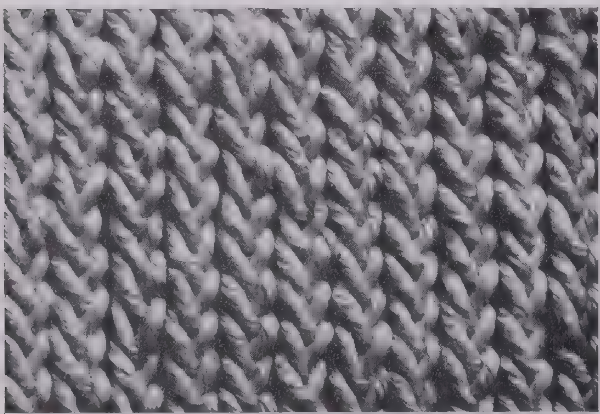

FIG. 45 *Crossed knitting* (left-over-right), 'stocking stitch.'

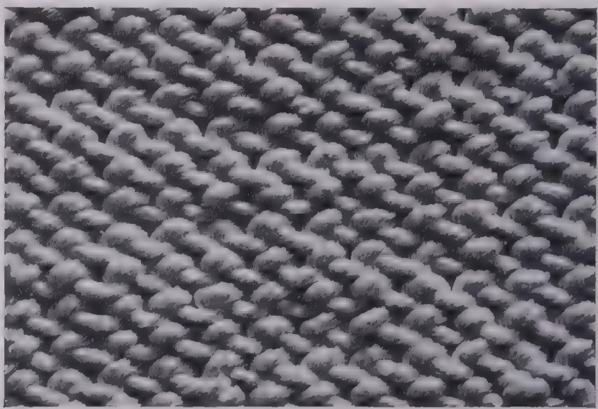

FIG. 47 *Crossed knitting* (left-over-right) 'stocking stitch' (opposite face of fig. 45).

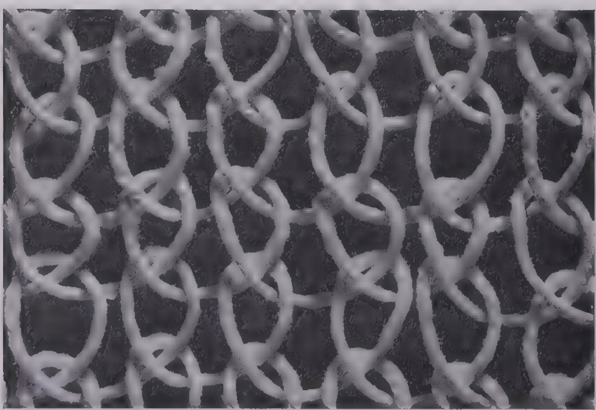

FIG. 46 Loosely worked construction of fig. 45.

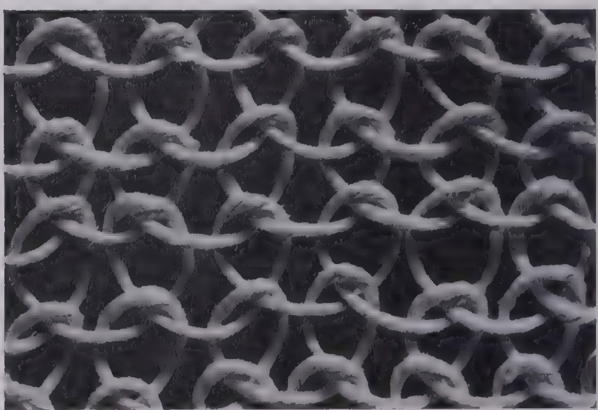

FIG. 48 Loosely worked construction of fig. 47 (opposite face of fig. 46).

B. VERTICAL AND LATERAL INTERLOOPING (*Crochet*)

Crochet is really a doubly *interlooped* structure (made with a hooked implement). Loops are interworked not only vertically with those in the previous row, as in knitting, but laterally as well – with others in the same row. It is basically a kind of chaining. A simple progressive chaining of the element forms the first row, and each successive row is a similar chaining which progresses horizontally and interworks vertically and horizontally at the same time (figs. 49 and 50).

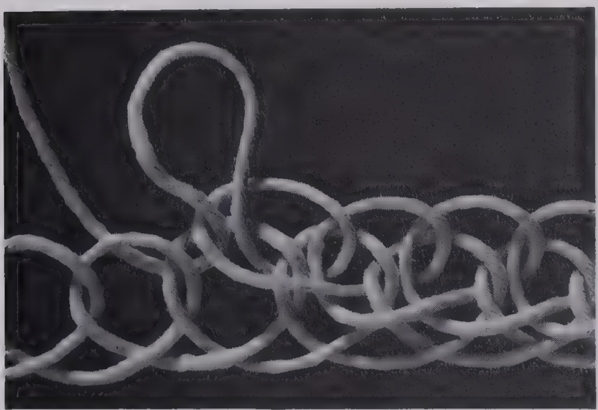

FIG. 49 Starting chain with part of the next row worked into it in *plain crochet* stitch (working face).

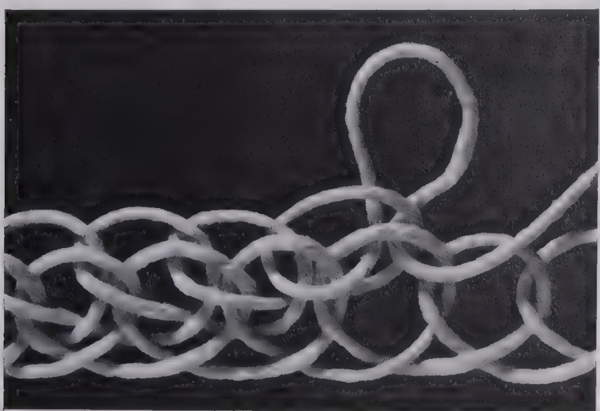

FIG. 50 Opposite face of fig. 49.

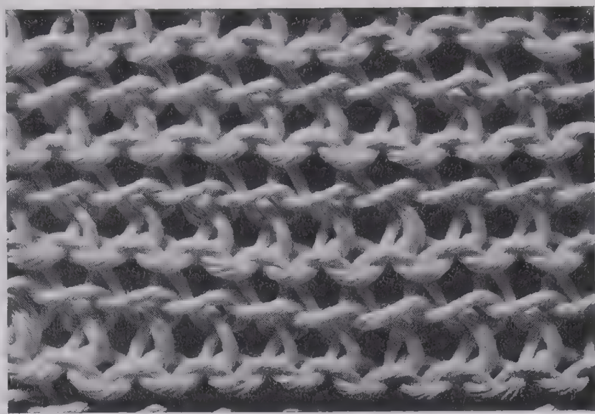

FIG. 51 *Plain crochet*, worked back and forth. The opposite face is *identical*.

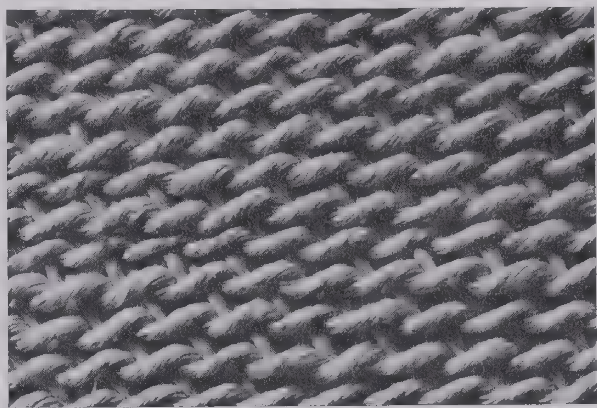

FIG. 52 *Plain crochet*, worked round and round.

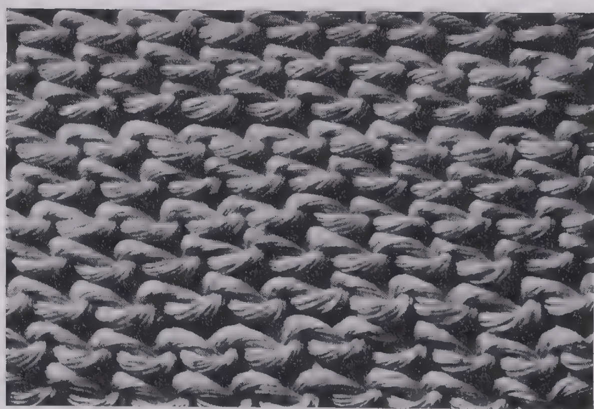

FIG. 53 Opposite face of fig. 52.

In the simplest stitch – *plain crochet* – each loop is drawn through two previous loops, the corresponding one in the previous row and the previous one in the same row. Worked back and forth the stitch will produce a flat fabric with *identical* faces (fig. 51). Worked round and round, the same aspect of all the stitches will be oriented to one face of the fabric (fig. 52) and the opposite face (fig. 53) will be *dissimilar*.

The simple stitch can be elaborated by increasing the number of loops made, and also by varying the order in which they are interworked, before the last previous loop is worked off the 'needle' and the new

stitch may be said to be completed. If a second loop is made before a new stitch is complete, the stitch may be called 'double' (figs. 54 and 55), if three are made, 'treble,' and so on. Names for the innumerable specific combinations (or elaborations) of stitches are usually descriptive of a general texture or effect, not of the structure, and they vary enormously from one time and place to another. They do not serve to identify specific structures unless accompanied by clear diagrams or detailed directions for making. The *identity* or *dissimilarity* of the two faces of the fabric depends on whether the fabric is worked round and round so that the same aspect of the stitch is always on the same face of the fabric, or generally back and forth so that one aspect is now on one face and now on the other.

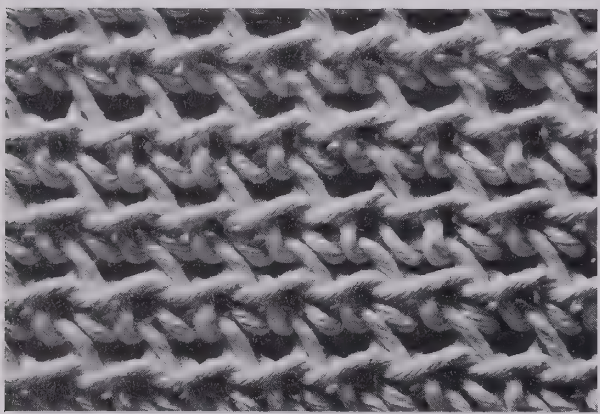

FIG. 54 'Double' *crochet stitch*, worked round and round.

The chaining principle of *crochet* work makes it especially adaptable to the construction of openwork; and since each stitch is secure as soon as completed, there are few restrictions on the way stitches can be varied and combined, and the fabric areas shaped. Consequently, many types of crocheted 'lace' have been developed, some imitating other lace forms, some exploiting the unique qualities and characteristics of crochet work itself. Figure 56 shows one very simple way of creating square or rectangular meshes and contrasting solid areas by varying the order in which simple crochet stitches are combined. Such textural contrast is useful for creating pattern and has provided the basis for the development of a number of types of crocheted lace. The possibilities of refinement, variation, and elaboration are almost without limit.

NOTE: that although the word *crochet* means *hook* and crochet work is not only done with a hooked needle but often defined in terms of that characteristic, it does not necessarily follow that a *single-element* fabric should be identified as *crochet* simply because hooked needles were used to construct it. If the structure is the *knitting* type of *interlooping*, that fact is in no way altered by the coincidental fact that there were hooked ends on the needles that were used. As a matter of fact, 'hooked knitting needles' have been quite commonly used in certain localities – used to produce the structure we know as *knitting*. The presence or absence of a hook on an implement should not enter into the identification of a fabric structure. Neither should the general appearance of the fabric. A structure which investigation proves to be the *crochet* type of *interlooping* should not be identified as *knitting* simply because it was made to look as much like knitting as possible and does actually resemble it in appearance.

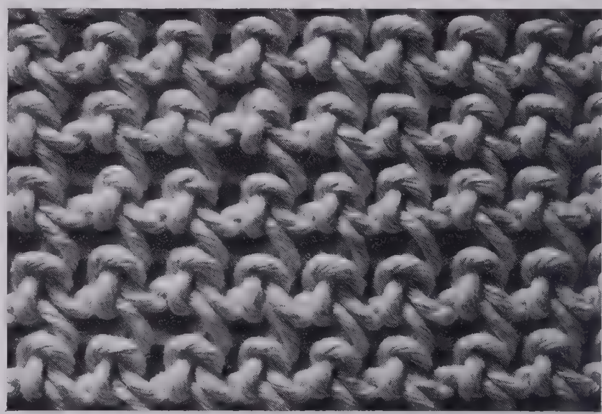

FIG. 55 Opposite face of fig. 54.

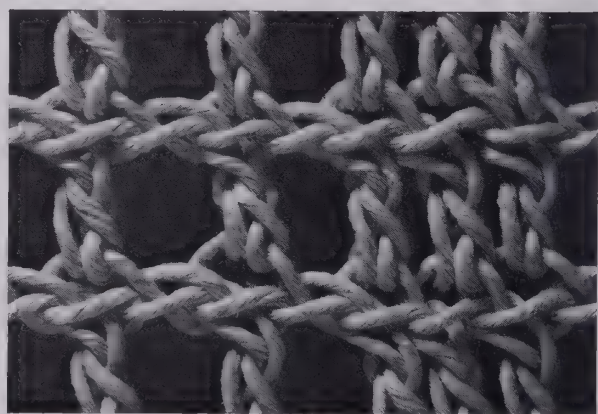

FIG. 56 Simple crochet stitches combined to form open meshes and solid areas. The opposite face is *dissimilar*.

Notes on the Use of Terms

Linking · Looping

The term *looping* is widely used in connection with *single-element* structures but is rarely defined or delimited. It is generally agreed that the word *loop* suggests the curved enclosing boundary of a space, and the idea of looping something over or round something else so that a loose fastening is formed is commonly accepted as part of the general concept. The term *looping* is used in this volume to distinguish such closed-curve fastenings from those described as *linking* because of their likeness to the linking of arms. *Linked* structures are often described in terms of the 'stitch' used to construct them (see p. 232 for definition of the term *stitch*) and the linking 'stitch' is variously referred to as 'a simple spiral stitch,' 'a wrapping stitch,' or as 'whipping' or 'overcasting.' *Whipping* and *overcasting* are common sewing terms (see p. 236). When used to describe *single-element* constructions they explain the working of the element on itself in terms of the working of a sewing thread in relation to a fabric. The expressions 'a simple spiral stitch' and 'a wrapping stitch' are more literal descriptions of the action taken in forming the stitch. Frequently, however, both *linked* and *looped* structures are designated by some very general term like *knotless netting* (v.i.) which does not describe or even indicate what connecting structure takes the place of the absent knot. Inasmuch as one *single-element* structure is distinguished from another almost entirely by the nature of the fastening or connection, it is useful to have the term *link* to designate the simple 'running' type of connection, and *loop* to denote the kind which is made when the active element doubles back on itself to form a complete closed loop each time it interworks with the previous row.

Coiling · Looping

The term *coiling* has suffered indiscriminate use in connection with *single-element* structures. It has been used to indicate a spiral or conical development of the fabric as a whole, but also, apparently, to describe the coil-like shaping of each stitch (presumably indicating the 'stitch' more commonly known as *simple looping*). The expression 'coil-without-foundation' certainly seems intended to refer to a structure built up in the manner of coiled basketry but without a foundation element — to refer, that is, to the development of the fabric as a whole. But if it refers to the spiral development of the fabric, we are left without information about the structure of the 'stitch.' There are, in fact, a number of such expressions — 'coiled netting,' 'lace coiling,' 'needle coiling' — in which there is nothing to indicate whether 'coiling' refers to the type of stitch, the shaping of the fabric, or both. It seems practical, therefore, to use the term *coiling* (or *coiled*) more as it is used in connection with basket- and pottery-making — to describe a way of building up and shaping the whole without implying anything about the structure of the individual stitches. The general type of stitch structure could then be designated by the term *looping* and the variety specified by descriptive terms such as *simple, cross-knit, figure-8, knotted buttonhole.* This would make it possible to specify both a stitch structure and a type of fabric development by the use of terms like *coiled simple looping* and *coiled cross-knit looping*, and the ambiguity of 'coil-without-foundation,' 'lace coiling,' 'needle coiling' and similar expressions could be eliminated by using them only for identification of general groups of spirally developed *single-element* fabrics.

Simple looping · Buttonhole stitch · Half hitch

The technique of *simple looping* has been adapted to so many different fabric requirements in the course of centuries of use in many parts of the world that descriptions of the structure are especially diverse in terminology. There are a number of expressions like 'quarter knot,' 'single Brussels stitch,' '*point de tulle simple*,' 'lace stitch,' 'needle hitching,' 'loop stitch,' 'single-loop technique,' 'buttonhole coil,' and 'coxcombing' which being of limited reference and use are also of limited usefulness. Other expressions like 'coil-without-foundation,' 'knotless netting,' and 'lace coiling' are indirect references at best, although they are sometimes used with the apparent intention of indicating the *simple loop* structure. *Buttonhole stitch* and *half hitch*, on the other hand, are quite commonly used, and both terms have the advantage of

specific meaning – each in its own field. *Buttonhole stitch* describes the *simple loop* structure in the language of work done with needle and thread, be it embroidery, plain sewing, or needle-made lace. *Half hitch* describes it more or less adequately for those familiar with rope-work.

It is probable, however, that the term *simple looping* is not only used more commonly than any other but is more generally understood. It has the advantage of being literally descriptive but without special connotation. The term itself suggests that the structure it refers to is one on which more elaborate structures are based, and the terms for the elaborations and variations (*loop-and-twist*, *cross-knit looping*, *figure-8 looping*, etc.) indicate relationship to the basic form, *simple looping*. In the preceding pages, the parenthetical addition of the terms *buttonhole stitch* and *half hitch* to the term *simple looping* is for the purpose of emphasizing and verifying the identity of the structure in terms of two familiar uses of it in different contexts.

Netting • *Knotless netting*

The term *netting* usually connotes an open textured *single-element* fabric with meshes of fixed dimensions secured by knots, although the word *netting* is not always defined specifically as a *single-element* structure and is often loosely used to suggest nothing more than an open-meshed net-like quality. Its use in the expression *knotless netting* is hard to justify, because *knotless netting* seems to be used as a general term for a somewhat indefinite group of structures of undefined characteristics and only remotely related to the general concept of *netting*. Most, but not all, of the structures that have been referred to as *knotless netting* would be classified as *single-element* structures, but certain *single-element* structures (*linking*, for example, or *interlooping* – either *knitting* or *crochet*) do not seem to be included in the designation, and obviously *knotted looping* would not qualify. So it appears that the word *netting* is not used in the expression 'knotless netting' for the sake of its implication of a *single-element* construction; and its implication of knotting is specifically denied. But neither does it necessarily indicate an open texture, for we find the term *knotless netting* used for groups of fabrics that include many compactly constructed ones of quite un-net-like quality.

Perhaps the term *knotless netting* was first used to describe fabrics that fitted the general idea of *netting* except for their lack of knots. Perhaps it was used for un-knotted fabrics made with a 'netting needle.' But whatever original justification there may have been, it does not now have sufficient definition to warrant its use in any but the most casual and generalized description.

Fortunately the term *netting* alone is somewhat more specific. It could be made even more so if it were to be used (in technical descriptions, at least) only for open-meshed structures that are *knotted*; but unless that connotation can be firmly established, it will continue to be necessary to use the term *knotted* in order to make a reference to *knotted netting* explicit. *Knotted looping* is explicit for *single-element* structures, whether compact or open, which have junctures secured by knots; and *net-like* can be used to indicate an open-mesh quality without implying the use of knots (for example, *net-like simple looping*).

Terms for knots

Inasmuch as the terminology of knots and rope-work provides names for almost every conceivable variety of knot structure, it has been customary to try to correlate fabric-making knots with the structures delineated and named in rope-work. There is one major difficulty. In rope-work, a knot is held to be a different knot and is given a different name if either the manner of tying it or the use to which it is put differs. There are a few recognized 'mesh knots,' but a number of other knots although used for fabric-making are not described or named in that capacity in the technical literature of knots; and when our information about a fabric is restricted to what we can learn from the specimen at hand, there is not likely to be any way of determining exactly how the knots were tied. As a result it is frequently possible to find the identical structure of a fabric-making knot diagrammed under a number of different names and have no basis for selecting the right one – or for guessing by what name our readers are most likely to recognize it. Do we use the term *cow hitch*, *lark's head knot*, or *reversed half hitches* when that construction is used as a mesh- or fabric-knot? How can we tell if we have a 'Martha's Vineyard knot' or if we are looking at the reverse of a 'mesh knot from over' – or is it a *weaver's knot*? There is certainly no re-

liable way of distinguishing the 'back' of a knot tied in one way from the 'face' of one tied in a different way if the structure is the same in both.

There are also names for a number of fabric-making knots in the terminologies of lace-work and embroidery. In either context the knots may be named in terms of the 'stitches' taken in making them, although the same stitches may not be called by the same names in both. What is called *knotted buttonhole filling* in embroidery may be called *point feston* in lace-work (depending on the author, of course – there is no more agreement in either of these fields than elsewhere). In both instances, however, the structure is often explained in more compatible terms as being made up of a certain combination of *buttonhole stitches* or *buttonhole loops*. The knot seems to have no equivalent in modern rope-work, but it is found in modern aboriginal (as well as ancient) fabrics and in that context is often referred to simply as *knotted looping*. Consideration of the different terms and descriptions led this writer to the conclusion that the designation *knotted buttonhole looping* would be quite generally understandable.

There are, however, no rules for selecting the most useful term for a particular knot. Borrowing a term from a particular nomenclature for use outside its usual field of reference is seldom justifiable, but when it is a term which is consistently and unambiguously defined and wholly applicable in the extended use, it may well prove to be more readily and widely understood and hence more useful than any other. When, for example, two *simple looping* stitches are worked close together and function as a knot, the rope-work term *clove hitch* has certain definite advantages over other terms for the same structure. Although the term is not in itself descriptive, it is in relatively common use, and the structure it refers to is easily identified. It is also more suggestive of the knotting function than a term like *two half hitches*, and is probably a more generally familiar term than a lace-making equivalent like *double Brussels stitch*.

Cross-knit looping · Needleknitting · Knit-stem stitch

The correlation between *single-element* fabric structures and those of sewing and embroidery which are in effect *single-element* structures worked into already existing fabrics (see p. 234) is well illustrated by *cross-knit looping*. The occurrence of this particular structure in different guises has led to considerable confusion in the use of existing terms and also to repeated attempts to rename the structure. Structures that are basically identical occur in a number of different categories: in *looped* fabrics (*cross-knit looping*), both net-like and close-worked; in *interlooped* fabrics (*crossed knitting*), usually close-worked; in embroidery (*cross-knit loop stitch*), worked in columns or to fill certain areas; and also as a 'covering' or 'veneering' stitch, worked round an object or core of some sort (unless worked into the material of the core, this constitutes a *looped* fabric structure rather than embroidery).

It may have been a mounting realization of the extent and variety of the use of this structure in the fabrics of pre-conquest Peru that inspired repeated attempts to find a single designation for a variety of forms whose relationship had not previously been given much attention. The terminologies of embroidery, rope-work, knitting, et cetera, provide various names by means of which certain uses of the structure can be identified but which, being terms associated with specific forms and uses, do not fill the larger need. When they are borrowed or interchanged, positive identification is as difficult as when a single term is used without qualification for all the related forms.

Terms like *Ceylon stitch* and *Van Dyke stitch*, for example, are embroidery terms for specific stitches. In themselves they suggest nothing about the nature of the stitches, and in no way do they indicate relationships between the two embroidery stitches or between the embroidery stitches and other fabric structures. References to 'a sort of braid stitch' or to 'a kind of chaining,' on the other hand, are too vague to mean much unless accompanied by explicit diagrams. The basis on which the use of the term *knit-stem stitch* is advocated is the debatable theory that the stitch is a variant of *stem stitch* – a theory and a term related primarily to the use of the structure for embroidery. 'Rib stitch,' a term sometimes used in rope-work for the 'covering' stitch which has the appearance of *crossed knitting*, suggests that appearance but is far from specific; and other rope-work terms like 'one strand Danish coxcombing' have little meaning out of context. 'Half hitch around half hitch' has been used to describe the structure when it is utilized for net-like fabrics ('knotless netting'), but it would be equally descriptive of *knotted buttonhole looping*.

Needleknitting is one of the terms 'coined' to express the idea of a fabric that is not really knitting although it looks like it. The term has been rather widely used in English publications on Peru in spite of many objections to it and in spite of the fact that its French equivalent (*tricot à l'aiguille*) has apparently been discarded in favor of lengthier but more descriptive expressions which distinguish one application from another. *Needleknitting* is a term which non-specialists find particularly misleading and confusing. It is used to designate the *cross-knit* structure in whatever form it occurs in Peruvian fabrics (I have not found evidence of its use for identical structures or constructions found elsewhere). It may describe the surface-covering 'detached' embroidery stitch (*Ceylon stitch*); the same stitch used to fill areas of design but not 'detached'; a single column of loops (*Van Dyke stitch*); columns two, three, or more loops wide, either attached or detached. It may also refer to the *cross-knit* structure when it is used as a 'covering' stitch – whether worked into the material of the foundation shape or not – as well as when it constitutes the entire structure of a fabric. Presumably true *crossed knitting* – the only use of the structure to which the term *needleknitting* is not applied – was not known in pre-conquest Peru.

It is easy to understand why this structure with its different applications and associations has been hard to fit with a useful name. It is difficult to find words which will indicate the structural similarity or identity of the various constructions and at the same time distinguish one from the other. A similarity to knitting has been expressed in some of the proposed terms, but none of them indicates the particular variety of knitting that not only looks the same but actually has the same structure – and is, in fact, the one variety which can be successfully and easily reproduced in these different ways. The identification of the structure with *crossed knitting* is specific, and that is why, in this volume, *cross-knit* has been used to identify the structures which reproduce *crossed knitting* but cannot properly be classified as *interlooping* (i.e. knitting). The corresponding *looped* structure is referred to as *cross-knit looping*; the corresponding embroidery stitch, as *cross-knit loop stitch* (see p. 243).

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PART TWO

Classification of the Structures of Fabrics

I Felted Fibers

II Interworked Elements

A. Single Element

B. Two Single Elements
(*see below*)

B. TWO SINGLE ELEMENTS

1. Linking stitches
2. Looping stitches
   Variations: *loop-and-twist, knotted loops*

Note on the classification of a related structure

NOTES ON THE USE OF TERMS

Foundation element • *Warp*
Lace • *Basketry*

SOURCES OF INFORMATION

B. Two Single Elements

Fabric structures composed of two single but differentiated elements are closely related to those composed of only one. The *two-element* structures are effected by interworking the *linking* or *looping stitches* of a *single element* with a second, or *foundation*, element. The element which forms the stitches is the active or *sewing element*. The other one is used concurrently as a relatively passive *foundation* or support round or through which the stitches are formed by the *sewing element*. In *single-element* structures the stitches are always interworked with previous ones – otherwise there would be no fabric. But when a second element is used as a *foundation*, the stitches connect successive passages of the *foundation element*, and the interworking of the stitch-forming element with itself is no longer essential to the coherence of the fabric.

Although the two elements are clearly differentiated in function, they may or may not differ in quality or in kind. Flexibility is an obviously essential characteristic of the element used for *sewing*, but there is no special qualitative requirement for the *foundation element*. The great latitude possible in the size, complexity of make-up, and flexibility of the *foundation element* is largely responsible for the marked differences in appearance and textural qualities that are found in fabrics which are structurally identical. In laces and many net-like fabrics the same thread or cord is used for both *sewing* and *foundation*, but an identical fabric structure may be found (in a basket, for example) in which the *sewing element* is relatively fine and flexible, the *foundation element*, a large and somewhat rigid unit often of complex make-up. Such qualitative differences in the elements are important items for descriptive analysis but should not be allowed to affect the identification of the structural type.

Classification of *two-single-element* structures is based primarily on the structure of the *stitch*, secondarily on the way it is used. Limited groups of specimens which show little or no stitch variation but considerable variation in the make-up of the *foundation element* can be further classified on that basis, but the *stitch* remains the primary determinant of structural type. *Two-single-element* structures, like the *single-element* ones from which they derive, can be developed either back and forth in the same plane or (if sufficiently flexible) round and round to form flat spiral, cone, or tube shape.

1. LINKING STITCHES

The 'running spiral' or *overcasting stitch* is often used in conjunction with a *foundation element* in exactly the same form as in *single-element simple linking* (fig. 7, p. 30). So used the stitches are said to be interlocked. They can be taken in such a way that one stitch encompasses two passages of the *foundation element* (fig. 57, *a*), or they can be made to include only one passage of the foundation without involving it in the *linking* (fig. 57, *b*). In either case the two faces of the fabric are *identical*. Since the *stitches* link with each other, the coherence of the fabric is not dependent on the presence of the *foun-*

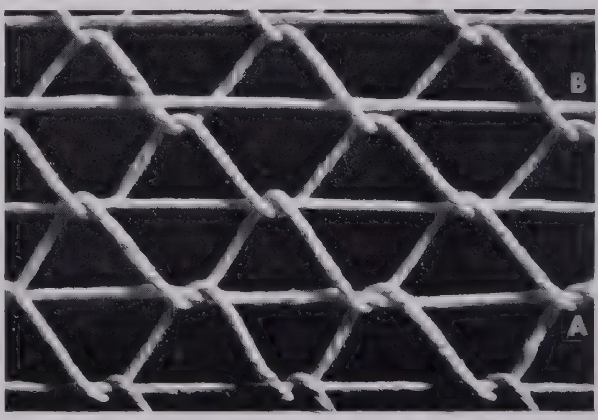

FIG. 57 *Simple linking* on a *foundation element* (interlocked stitches).

dation element, although the nature of the foundation will have a definitive effect on the general nature of the fabric as well as on the textural qualities.

On the other hand, if the stitches do not 'interlock' (i. e. interwork with each other) the *foundation element* is essential to the very existence of the fabric (fig. 58) besides influencing if not determining its nature and general shape. The two faces of the fabric are *identical*.

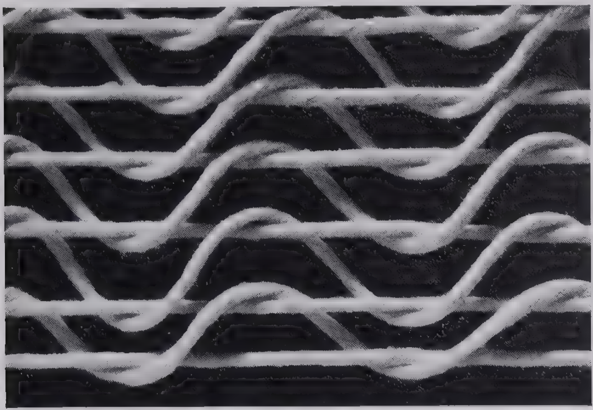

FIG. 58 *Linking* on an identical *foundation element* (stitches not interlocked).

There are many examples of the use of *linking stitches* which are worked (as illustrated here) on a foundation element identical with the sewing element; but the stitch is also widely used, in 'sewn' or 'coiled' basket-work, for example, with a flexible *sewing element* securing passages of a proportionately heavy and often complex *foundation element*.

2. LOOPING STITCHES

The *looped* structure most commonly used with a flexible foundation element is the *simple loop* (or *buttonhole stitch*). It is used in many of the same ways as *single-element simple looping* and like *simple looping* may be loosely worked (fig. 59) or compactly constructed for a more cloth-like texture (fig. 60). Both textures are utilized in needle-point lace and are described by a variety of such special 'lace' terms as *point de Venise* for the open texture and *point d'entoilage* for the close. (Both textures are also found in 'detached' embroidery.) The two faces of the structure are *identical*.

Figure 61 illustrates some of the differences in effect that are produced when the same *sewing element* and the same stitch (used for the constructions in figs. 59 and 60) are used with a markedly different *foundation element*. A single rod is used here as an abstract representation of all 'larger and more rigid foundation elements' (including all the combinations of qualities and groupings of parts that are possible).

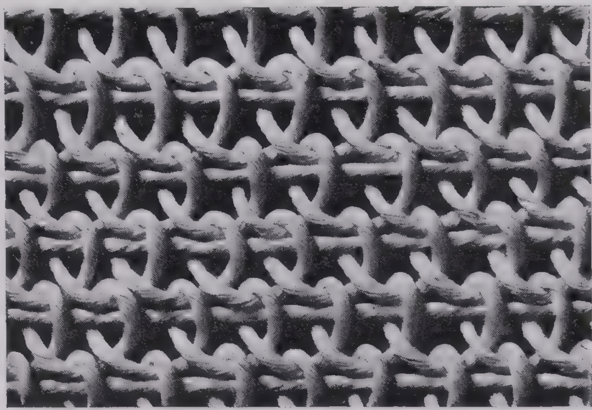

FIG. 59 *Simple looping* on an identical *foundation element* (interlocked stitches).

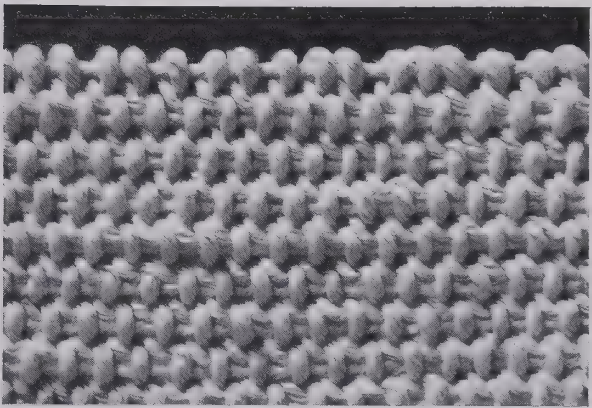

FIG. 60 *Simple looping* on an identical *foundation element* (close-worked fabric with interlocked stitches).

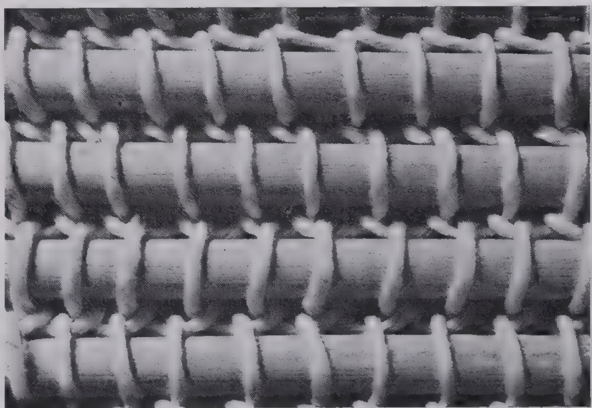

FIG. 61 *Simple looping* on a rigid *foundation element* (interlocked stitches).

It should be noted, however, that when the foundation element is composed not of a simple unit but of a group of separate parts used as a unit, the stitches can be worked through as well as round it. In addition to modifying the structure, this may produce dissimilarities in the two faces of the fabric.

Since *looping stitches* form closed and complete loops, they are seldom if ever used simply to connect passages of the foundation element without interworking with each other – as *linking stitches* are used in figure 58, for example. Even if each loop encompasses two passages of the *foundation element* and actually depends from it, the loop, being closed, will almost inevitably also encompass at least one previous passage of the *sewing element*.

VARIATIONS: *Loop-and-twist, knotted loops*

Other *looping stitches* are sometimes used in conjunction with a *foundation element*. Among them are the *loop-and-twist* variation of *simple looping* (fig. 62) and various *knotted loops* of the *suspended knot* type like the 'overhand' *simple knot* (fig. 63, *a*) and the *clove hitch* (fig. 63, *b*).

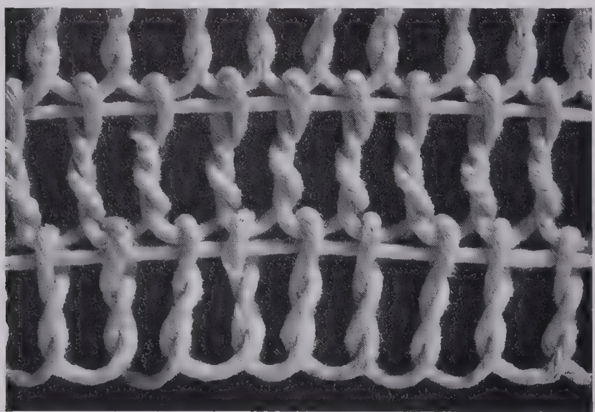

FIG. 62 *Loop-and-twist* on a *foundation element.*

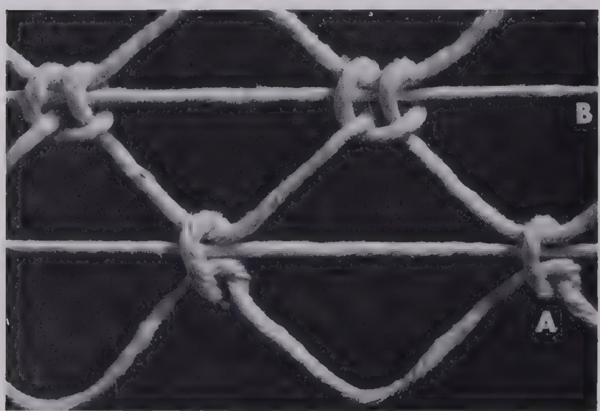

FIG. 63 *Knotted loops* on a *foundation element:* a) *simple knot*; b) *clove hitch*

NOTE ON THE CLASSIFICATION OF A RELATED STRUCTURE

Wrapping one element round another is one of the most elementary methods of fastening separate units together or adding unit to unit in the construction of fabrics. *Linking* (p. 30) is primarily a fastening of one passage of a *single element* to another by repeatedly and at regular intervals 'wrapping,' or winding, it part or all the way round the previous passage. In *linking* on a *foundation* (pp. 52 f.) successive passages of one element are secured by being 'wrapped' in a similar running-spiral fashion by a second element. In both these structures the general directional trend of the *wrapping element* is the same as that of the element it repeatedly wraps. But there is also a kind of wrapping in which one element successively crosses and encircles each of a series of elements running more or less at right angles to it. *Wrapping* of this sort can be described as progressive (see p. 214). It is extensively used, and with such freedom and diversity of application that it is exceptionally difficult to classify. References to it should identify both the essential structure (*wrapping*) and its particular application.

When there are vertical elements recognizable as warps, a horizontal *wrapping element* (fig. 64) can, without danger of misunderstanding, be referred to as a *weft element*. If such *horizontal wrapping* is

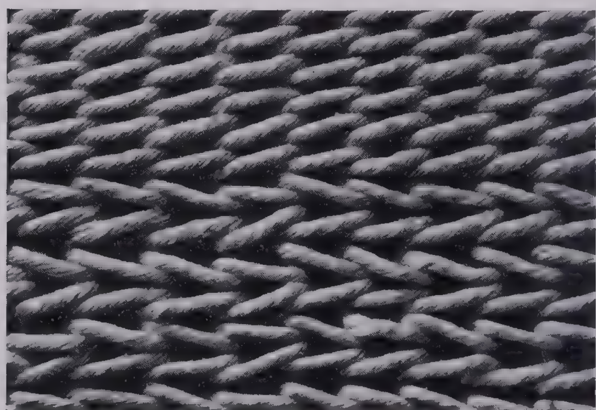

FIG. 64 *Horizontal wrapping* on vertical elements; plain (above) and 'countered' (below). The opposite face is *dissimilar*.

used for an 'extra-weft' structure added to a ground weave (see p. 218), it is quite commonly identified as *Soumak,* from the flat-woven rugs of that name; but if there is no separate ground weave, that is, if the horizontal wrapping round vertical elements constitutes the fabric (see p. 215), the terminology may be less consistent. Expressions like 'Soumak wrapping' and 'wrapped weave' are sometimes used; but a writer more familiar with embroidery than with rug weaving may describe the structure as 'stem stitch on bare warps.' Another, lacking a definitive term, may simply describe the details of a particular example.

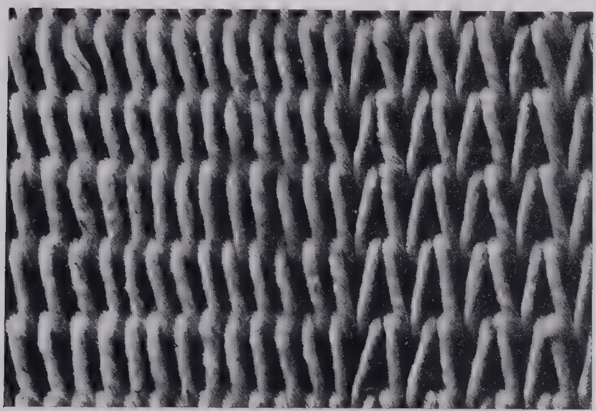

FIG. 65 *Vertical wrapping* on horizontal elements; plain (left) and 'countered' (right). The opposite face is *dissimilar.*

When the *wrapping element* is worked vertically on horizontal threads or cords (fig. 65) or on an element wound spirally round a core, the *wrapping* is apt to be referred to as 'vertical stem stitch'; and *horizontal wrapping* that is worked spirally on elements which parallel a core or foundation shape, as 'horizontal stem stitch.' Each particular example of the use of *wrapping* can, of course, be individually classified according to its particular combination of elements or sets of elements—as *two single elements, two sets of elements,* a *single element* on a *foundation set,* a *set of elements* wrapping a *single foundation element,* and so on. When there is a core or base that shapes the work and supports the *foundation element* (or set of elements), it is not unreasonable to construe the core, or base, as a 'fabric' and the *wrapped* construction as a 'structure added to a fabric,' that is, as a form of 'detached' stitchery (see p. 244). Wrapping stitches always slant slightly, and the slant can be reversed at any point. If it is regularly reversed in alternate rows, the structure is sometimes erroneously identified as *knitting.*

Notes on the Use of Terms

Foundation element · Warp

The use of the term *warp* to designate a *foundation element,* as distinguished from the *sewing element* that binds its successive passages into a fabric, is unfortunate because it is based on only a part of the general concept of *warp.* By consensus of definition, the term *warp* (see p. 74) refers to 'yarns or threads running lengthwise in a fabric, crossed (interworked) by the *weft.' (Warp* usually refers to the aggregate of such threads in the loom or fabric, reference to a single one being made specific by terms like *warp end* and *warp thread.*) Certain elements are common to the great majority of definitions reviewed: reference to a group of threads (usually to threads arranged or to be arranged on a loom or frame); reference to threads having a common and consistent (lengthwise) direction; and reference to threads which are crossed (or interworked) by another (horizontal) group of (weft) threads. Most definitions imply (if they do not specifically state) that the *warp* constitutes the *foundation* on or through which the weft threads are worked. But using the term *warp* for an element which functions as a foundation but is related in no other way to the general concept of warp is hardly justified, especially when even the 'foundation' idea is not precisely the same in the two uses. In definitions of *warp,* the word *foundation* describes the fact that the warp threads act as a basic structure which has been set in place before being interworked by the weft; whereas the *foundation element* of a *two-single-element* structure is a foundation in the sense that it is a supporting and shaping element. The 'setting in place' and the interworking by the *sewing element* are practically simultaneous.

If the term *warp* were used only in its customary sense, it would always identify a vertical set of elements used in association with at least one set of horizontal (weft) elements, usually on a loom. The term *foundation element* would distinguish and describe the function of one element in relation to an accompanying but differentiated element in a *two-single-element* structure. And with this distinction maintained it would be possible to eliminate the confusion engendered by the use of such expressions as 'vertical wefts,' 'horizontal warps,' 'flexed warps,' and 'coiled netting on warps.'

Lace · Basketry

The terms *lace* and *basketry* describe two qualitatively divergent developments of fabric art which have many 'techniques' and structures in common but share almost no terms. Lace, although apparently not called *lace* until considerably later, emerged as a distinct fabric type during and after the 15th century in Europe. With fashion demanding fabrics of increasingly fragile and elaborate elegance, centers of production grew up, each tending to specialize in the development of particular techniques and types of design. The detailed terminology of lace reflects the history and geography of its development and is based more on place association than on technical features. Basketry, on the other hand, has been developing through the ages and all over the world in uncounted varieties of material, shape, size, quality, and technique. Its nomenclature is usually more or less descriptive of structural types and variations, although the use of terms is not standardized.

Nevertheless, lace and basketry can be traced to common structural sources, and the primary classification of each is based on structural characteristics that are surprisingly alike. Laces are usually classified as: *needle-made*, or *needle-point*, *laces*, made with needle and thread (technically a form of sewing); and *bobbin*, or *pillow*, *laces*, made with a group of many separate threads whose handling is facilitated by the use of bobbins and pillow. A single continuous thread is used for *needle lace*; whereas the separate threads of *bobbin lace* are fixed at one end, weighted (by the bobbins) at the other, trend in the same direction, and constitute a *set of elements*. In other words, *needle laces* are *single-element* and *two-single-element* structures; *bobbin laces* are *one-set-of-element* forms. The primary classification of basket-work is analogous. There are two main types: *coiled* (or 'sewn'), *single-element* and *two-single-element* structures whose construction is technically sewing; and so-called 'woven' basket-work which includes *interlaced* structures, both oblique (*one-set-of-elements*) and right-angled (*two-or-more-sets-of-elements*), and also *twined* structures which are usually of *two-sets-of-elements*.

Structures made up of either a single set of elements or of two or more sets will be discussed in succeeding sections, but we have already encountered the problem of accurate identification of those *single-element* and *two-single-element* structures which are found in lace at one end of the scale of delicacy, in basketry and matting at the other, and in many intermediary forms which cannot be considered either basketry or lace. Specialists in all fields make use of many special terms which are of value and significance chiefly to fellow specialists. But inasmuch as there are structures common not only to the divergently developed fabrics of lace and basketry but also to less elaborately specialized fabric forms, it is important to have terms-in-common by means of which the structural relationship between fabrics of otherwise unlike qualities may be known. The need for terms which are applicable and understandable in different fields is heightened by the lack of agreement among specialists on the use of terms in their own special fields.

On account of the diversity of 'lace-making' terms, no attempt has been made in this volume to list a representative group of 'lace' terms for any one structure. Terms have been cited largely for the purpose of indicating the 'lace' association of certain structures and are not necessarily the ones which would be most acceptable to specialists. The basketry terms that are used are largely terms whose applicability is not restricted to basket-work (see pp. 210 f. for a few others).

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PART TWO

Classification of the Structures of Fabrics

I Felted Fibers

II Interworked Elements

A. Single Element

B. Two Single Elements

C. One Set of Elements
(*see below*)

C. ONE SET OF ELEMENTS

1. Interlinking (plaiting)
   Variant use: *spiral interlinking*
   Variations
2. Oblique interlacing (braiding)
   Variation: *oblique twill interlacing ('twill braiding')*
3. Oblique twining
   Single
   Double
4. Inter-knotting (macramé)

Notes on special methods
Sprang
Bobbin lace

NOTES ON THE USE OF TERMS

Interlinking • *Plaiting*
Braiding • *Braids* • *Sennit* • *Oblique interlacing*
Oblique twining • *Twine-plaiting*
Sprang • *Frame-plaiting* • *Loom-braiding*
Macramé • *Square knotting* • *Inter-knotting*

SOURCES OF INFORMATION

C. One Set of Elements

A set of elements has been defined (p. 27) as a number of elements "all used in a like manner, that is, functionally undifferentiated and trending in the same direction." When a fabric is composed of only one such set, the directional trend of the set is usually vertical; but, in order to interwork with others of the same set, the individual elements move now to the right, now to the left, for distances largely dependent on the type of interworking. Even if they cross one another at right angles, they all follow similar zigzag courses, and the over-all trend is the same for all. No element moves consistently in one direction (or on one diagonal) to the exclusion of the other.

The elements that make up a single set are said to have a common starting point. They may actually be fixed at the same point; or they may be arranged parallel to each other so that the 'starting point' is really a 'starting line.' There are many ways of arranging the elements for interworking. They may hang free or lie across a supporting surface. They may be individually weighted, or stretched between cords or beams. The method of handling, however, is largely a matter of convenience and control. It seldom affects the structure of the fabric.

Although there may be no way of knowing how the elements of any given fabric were arranged or handled in the process of construction, the way they actually interwork with one another in the fabric structure can be determined. Classification, therefore, rests on the four essentially different ways in which the undifferentiated elements of a single set can be interworked:

1. *Interlinking* (or *plaiting*), which is interworking by means of the simple connection between parts that is termed *linking* in *single-element* structures, and called *interlinking* when it is used in the multiple action of interconnecting the elements of a single set.
2. *Oblique interlacing* (or *braiding*), which is a flat over-and-under interworking, the nature and order of which is frequently the same as that of interwoven *warp* and *weft* elements, but which is clearly distinguished (if there is an edge intact) by the oblique crossings of the elements and their common directional trend.
3. *Oblique twining*, in which pairs of elements, twining about each other, enclose elements on the opposite diagonal course.
4. *Inter-knotting* (or *macramé*), in which elements are knotted with or round adjacent ones, first to one side and then the other — often but not necessarily used for fringes.

A single set of undifferentiated elements, particularly with free-hanging ends, offers almost unequalled opportunity for varying the manipulation of the elements at will and for combining different types of structure in a single fabric. Although the *one-set-of-element* structures are especially appropriate for narrow fabrics, very few of them are restricted to that use.

1. INTERLINKING (Plaiting)

The terms *interlinking* and *plaiting* are not always considered equivalent because *plaiting* is not only used but defined in quite contradictory ways. For example, the term *plaiting* is frequently used (without definition) to designate the process of making 'bobbin lace' and other constructions similarly composed of a single set of elements with a common starting point. At the same time, many definitions relate *plaiting* to *braiding*, although agreement on the relationship is lacking and we find *plaiting* defined as 'synonymous with braiding,' as 'a form of braiding,' and as 'including braiding.' *Plaiting* is also defined as synonymous with *weaving* 'when all weaving elements are of like quality.' Since this presumably refers to so-called 'finger-weaving' or 'weaving without a loom' it is a method of handling elements that is being called *plaiting*, not a fabric structure.

It seems that before the term *plaiting* can be used

effectively its meaning will have to be clarified and its connotations differentiated from those of *braiding* and *weaving*. For example, by limiting the term *plaiting* to one-set-of-element structures in which the elements *interlink* with adjacent ones (figs. 66-71), and the term *braiding* to those 'one-set' structures in which the elements *interlace* with each other *obliquely* (figs. 72-77), both terms would be given more precise meaning and the term *weaving* could be used, without ambiguity, to denote *warp-weft interlacing* of two-or-more-sets-of-elements (see pp. 75 ff.).

Interlinking is the structure produced by the *link* type of connection (p. 30) between undifferentiated elements of a single set. Elements consistently *link* with adjacent or nearly adjacent ones on either side and change their relative positions only slightly throughout the fabric. In the simplest form of *interlinking* (fig. 66) each element zigzags back and forth, linking alternately with one to the right and one to the left. If, when two elements cross, the one from the right passes down, over, and back under the one from the left, the crossing is described as right-over-left, and vice versa.

If the direction of the crossing of the elements is consistent, laterally compacted *interlinking* will show horizontal wales (fig. 67). More evenly worked, consistent crossings tend to produce an appearance of continuous diagonals across the fabric even though no element moves more than one 'link' to right or left of its original position. Organized reversal of the crossings is used to create areas with contrasting diagonals. The two faces are *identical* in structure, direction of diagonals, and crossings.

VARIANT USE: *Spiral interlinking*

If the trend of the *interlinking* elements is *spiral* instead of vertical, the appearance of the fabric will be altered even though the structure of the *interlinking* is not. If the spiral trends down to the right, for example, rather marked verticals will be produced if the elements cross right-over-left (fig. 68), horizontal ridges, if they cross left-over-right (fig. 69).

FIG. 66 *Interlinking*, or *plaiting* (crossing right-over-left).

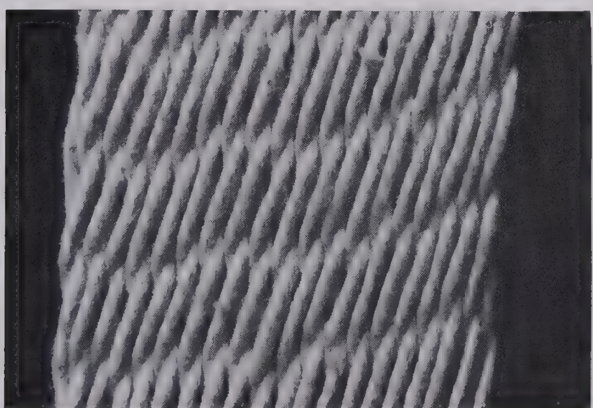

FIG. 67 Interlinking – same structure as in fig. 66 compacted laterally.

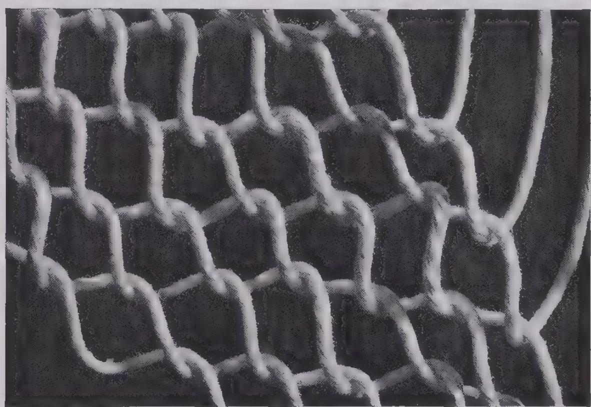

FIG. 68 *Spiral interlinking*, down to the right spiral, elements crossed right-over-left.

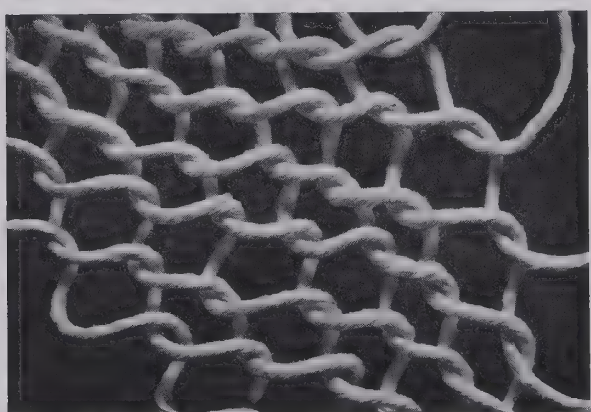

FIG. 69 Same spiral as fig. 68, crossed left-over-right.

VARIATIONS

One widely used variation of *interlinking* is effected by the addition of one or more twists to the link (fig. 70). It is used at times for entire fabrics, at times in conjunction with plain *interlinking* for openwork effects and textural variety. Another common device for creating open spaces is the omission of certain links in the regular order of interlinking (fig. 71). These and other variations are sometimes combined to produce intricate and beautiful patterning in structurally simple fabrics.

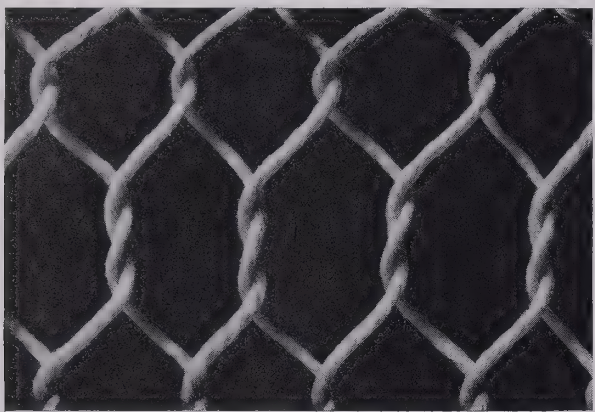

FIG. 70 *Interlinking*, with an added twist in one row of links.

FIG. 71 Open space created by the omission of one link in the regular order of *interlinking*.

NOTE: that when a set-of-elements is stretched between two cords or beams the interworking can be effected at both ends simultaneously. Presumably it is this *way of working* that is specifically denoted by the term *sprang* (see p. 66). Simple *interlinking* and the variations shown here often occur in (or constitute) fabric structures which are referred to as *sprang*.

2. OBLIQUE INTERLACING

(Braiding)

Interlacing might be said to be the most straightforward way of interworking elements, inasmuch as each element simply passes under or over elements that cross its path. Properly organized, this over and under crossing of elements will produce the coherence necessary for a fabric, without fastening one element to another by any sort of *linking*, *looping*, *wrapping*, or *knotting*. When undifferentiated elements with a common starting point are *interlaced*, the course of the elements is oblique to the edges of the fabric, and the structure differs from that of *interlinking* not only in the nature of the interworking but in the fact that changes of direction usually occur only at the edges of the fabric where the elements turn back on the opposite diagonal (fig. 73).

The general principles of *oblique interlacing* are exemplified in its simplest manifestation, the three-strand braid, familiar to all by reason of its many commonplace uses. Countless developments and elaborations of it are effected by two basically simple devices: increasing the number of elements employed, and altering the order of the interlacing in one way or another. The effect of merely increasing the number of elements surely needs no comment, and discussion of the effect of changes in the order of interlacing will be limited to a few simple examples which illustrate the essential nature of *oblique interlacing* and show its relationship to the right-angled *interlacing* of differentiated *warp* and *weft elements* in *woven* fabrics, or *textiles* proper. (The interlacing of 'square-' and 'round-braids' will not be reviewed.)

Oblique interlacing and *weaving* are both forms of *interlacing*, and whenever the *order* of interlacing is the same in both, the same term is likely to be used to designate it. Nevertheless, the structural types are different and the distinction should be evident in the designation. The common starting point and directional trend of the elements – elements that are oblique to the edges of the fabric and do not necessarily cross each other at right angles – distinguish *oblique interlacing* from *weaving* proper even when the order of the interlacing is the same.

Figure 72 shows a *plain* (over-one-under-one) *oblique interlacing* entirely comparable to a *plain-weave* textile except for the oblique trend of all elements without differentiation. Figure 73 shows the turn of the elements at the edges of the fabric.

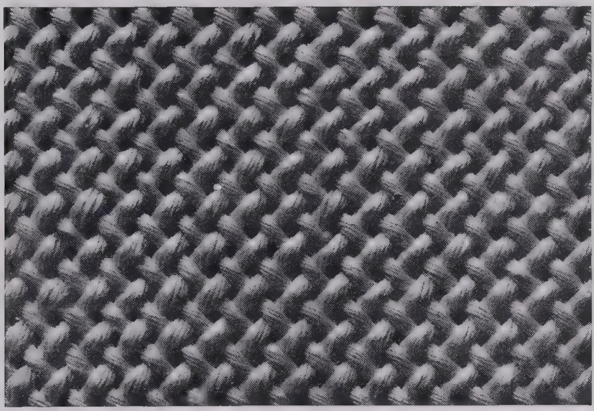

FIG. 72 *Plain oblique interlacing*, or *'plain braiding.'*

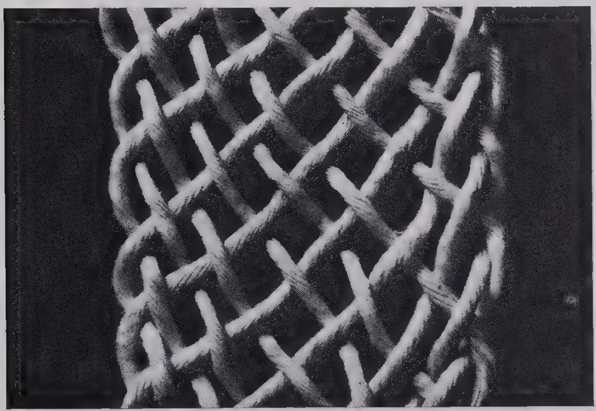

FIG. 73 Loosely worked construction of *plain oblique interlacing*, showing change of direction at the edges.

Paired, tripled (fig. 74), or multiple elements are often used as units in the same *plain* order of interlacing, sometimes in combinations that produce diagonal ribbing. All these, like their counterparts in woven textiles, are *identical* on the two faces.

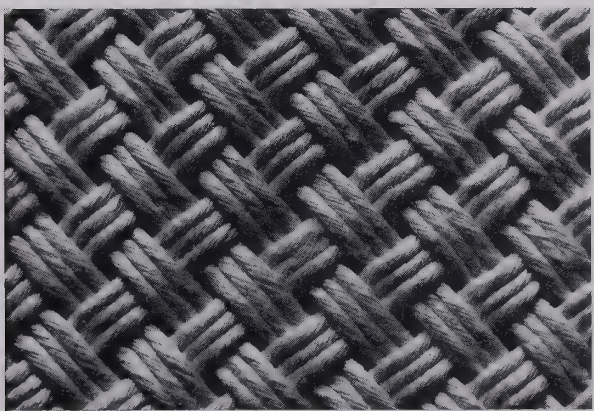

FIG. 74 *Plain oblique interlacing* with tripled elements.

VARIATION: *Oblique twill interlacing ('twill braiding')*

The *twill* type of interlacing develops naturally when the elements of a single set, although used singly, pass over and under more than one element at a time. As one element after another turns back at the edge of the fabric to continue, say, an over-2-under-2 interlacing on the opposite diagonal, the 2/2 grouping is automatically shifted by one element. Such a stepped system of shifts in the groupings of interlaced elements is the basis of *twill* structures. The points of interlacing shift in echelon, one element at a time, one interlacing after another, producing a structure in which no group of elements is maintained as a group in successive interlacings.

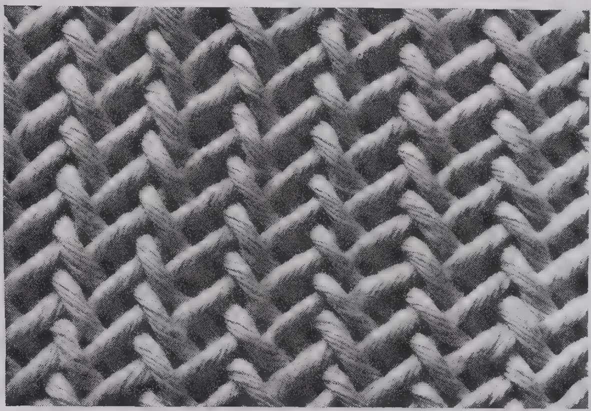

FIG. 75 *Oblique 2/2 twill interlacing*, or 2/2 *'twill braiding.'*

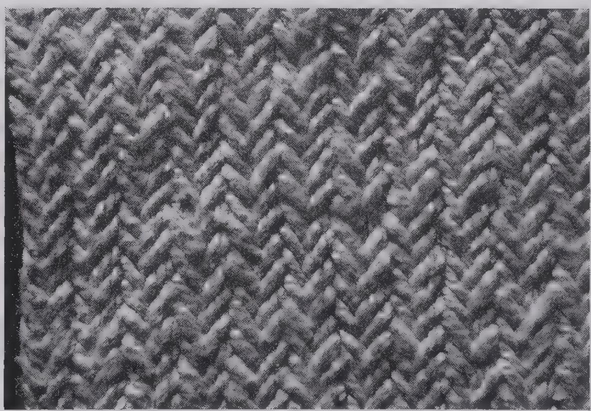

FIG. 76 Long edge of an *oblique 3/3 twill interlaced* fabric (a Hopi cotton 'frame-braided wedding sash').

Figure 75 shows *oblique 2/2 twill interlacing* with the elements crossing at right angles; figure 76, one edge of an *oblique 3/3 twill interlaced* fabric where each element reverses its diagonal course.

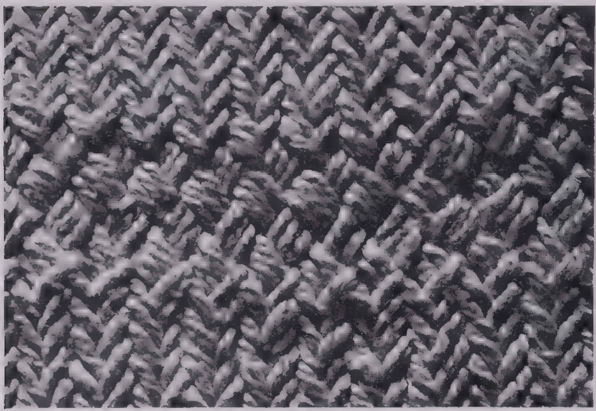

FIG. 77 *Oblique 3/3 twill interlacing*, combined with *plain oblique interlacing* with tripled elements, in a Pueblo cotton sash.

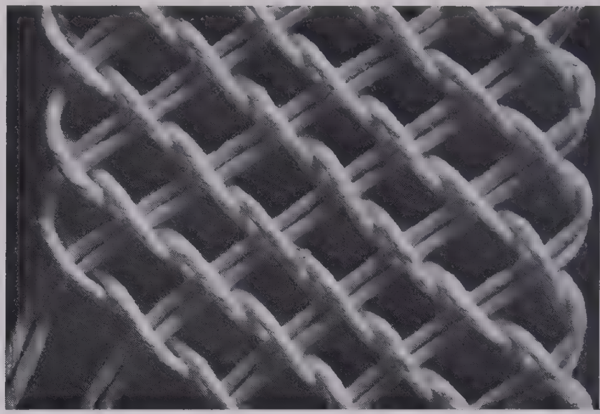

FIG. 78 Diagrammatic construction of *single oblique twining* (twining on only one diagonal at a time).

Figure 77 shows a brief shift from the *oblique 3/3 twill interlacing* of figure 76 to a *plain oblique interlacing* of units of three elements each.

NOTE: that in fabric form (that is to say, barring round, square, and very narrow 'braids'), *oblique twill interlacing* is usually 'even'— that is, over and under an equal number of units (2/2, 3/3, etc.) — and its two faces structurally *identical*.

3. OBLIQUE TWINING

In descriptions of fabric structure, the term *twine* is so commonly used to denote a turning of two or more elements about each other so as to enclose other elements, that it should be restricted to that use. The term *twist* will then distinguish a simple turning of two or more elements about each other *without* enclosing others.

> *To twist:* to combine (two or more elements) by winding together.
>
> *To twine:* to enclose one or more elements in the *twisting* of two (or more) others.

SINGLE In *oblique twining*, pairs of elements moving on an oblique course enclose elements moving on the opposite diagonal as they twine about each other. The elements thus enclosed may be proceeding singly or in pairs, but in either case, the *oblique twining* is said to be *single* if, in a given area, the twining elements all move on one diagonal while the elements on the opposite diagonal are all passively enclosed. In *single oblique twining*, then, all elements necessarily change their 'roles' when they turn at the edge of the fabric to proceed on the opposite diagonal (fig. 78).

If, throughout a close-worked fabric, all elements twine when on one diagonal and not when on the other, and if the direction of the twining itself is constant, the fabric will show marked diagonal ribbing. However, a 'change of roles' elsewhere than at the edges of the fabric will reverse the direction of the diagonal ribbing at that point. By consistently changing the roles of the elements at the longitudinal midpoint of the fabric, for example, a chevron ribbing is produced, and if the whole structure is reversed at the transverse median line as well, a diamond pattern will be formed in the center of the fabric. The structure and the direction of the turn of the twining elements is *identical* on the two faces of the fabric, but the direction of the diagonal ribbing is reversed on the opposite face.

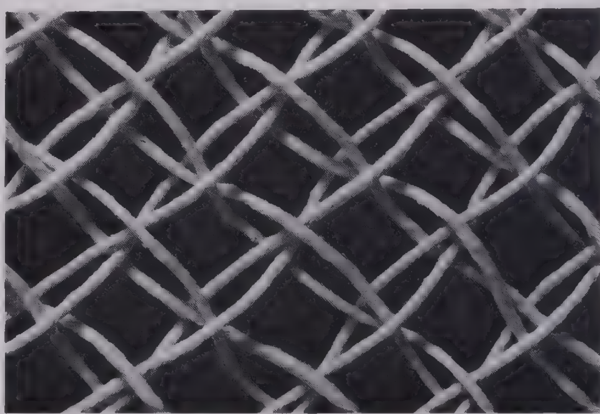

FIG. 79 Diagrammatic construction of *double oblique twining* (twining on both diagonals) when one twining pair encloses another. (In a variation common in Peru and elsewhere, each twining pair encloses only one of the opposite pair.)

DOUBLE *Oblique twining* can be described as *double* when the elements consistently function in pairs and twine continuously on both diagonals (fig. 79). There is no 'change of roles' and no marked diagonal ribbing. It is sometimes difficult to distinguish this more even-textured kind of *oblique twining* from *plain oblique interlacing*, particularly when both are used in the same fabric. The two faces of the fabric are *identical*.

4. INTER-KNOTTING (Macramé)

Another familiar way of interworking the free-hanging elements of a single set into a fabric is by *knotting* elements round adjacent elements first to one side and then to the other. This use of *knotting* is especially suited to fringe construction (although not restricted to it), and warp or weft elements extending beyond the woven portion of the web often constitute the necessary 'set.' *Macramé*, a term credited with an Arabic origin and said to mean *fringe*, is frequently used to designate ornamental knot-work in general. As commonly used in English, French, and Spanish, it is somewhat more specifically defined as 'ornamental fringe of knotted threads'; and usage tends to extend the meaning still further to include any fabric structure composed of a set of undifferentiated elements interworked by *knotting*.

Knots and combinations of knots that are structurally identical occur in fabrics ranging from coarse to very fine, from heavy to delicate. For fine lace-like work, a pillow and pins may be utilized much as they are in making *bobbin lace* (see p. 67) and this work may be referred to as *macramé lace*. When the same structures occur in so-called 'fancy rope-work,' the work is more likely to be identified as *square knotting*, although the term *macramé* (but not *lace*) is sometimes used in that context as well. The fringes and fabrics that have the same structures as these but cannot be called either 'lace' or 'rope-work' are usually referred to as *knotted fringes* or *knot-work*.

The use of the term *square knotting* as the rope-work equivalent of *macramé* is evidence of the extent to which the *square knot* is utilized in this type of work. It is not, however, always considered the 'basic knot.' Figures 80 and 81 show it as it is most commonly used, that is, to knot pairs of elements round other pairs with the reiterated grouping and re-grouping of elements necessary to produce a fabric. When a horizontal *square knot* is tied as it is here, by two elements round two others, it is called a *Solomon knot*, and is considered by some to be the basis of all 'one set' *inter-knotting*, or *macramé*. However, half of a *Solomon knot* (called a *half knot*) is what others refer to as the 'basic knot of *macramé*,' and is the knot that, in the language of 'square knotting,' is known as the *macramé knot*.

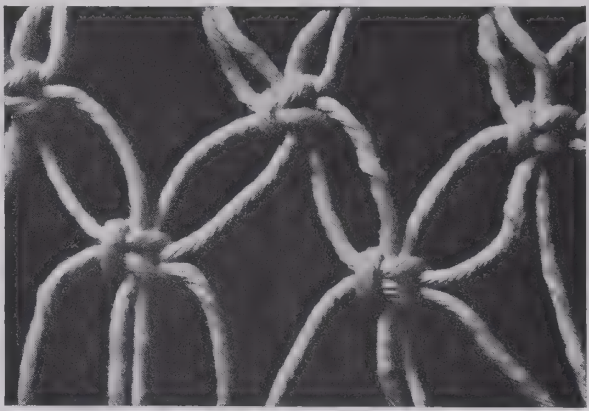

FIG. 80 Section of fabric composed of so-called *Solomon knots*.

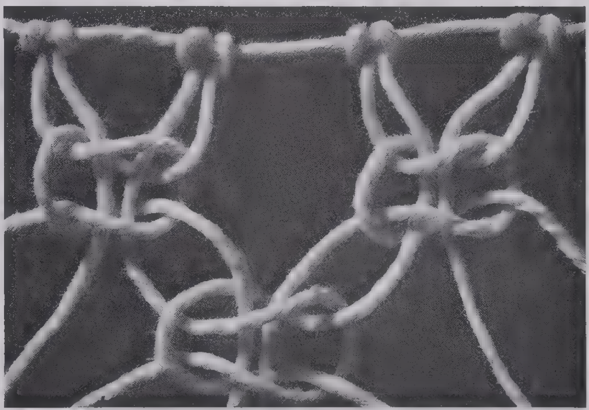

FIG. 81 Loosely worked construction of *Solomon knots*, showing the two *half knots* of which each is composed, and the use of *cow hitches* for attachment to the starting cord.

It is typical of *one-set-of-element* fabric structures made by *inter-knotting*, that knots are tied round, or enclose, groups of elements without engaging them in the knotting action. *Half hitching* round such 'leaders' or inactive elements is done in a great variety of ways. Either in series, like a succession of *clove hitches*, or reversed as in the *cow hitch*, the *half hitch* is used for many of the vertical and other 'bars' of *macramé* or *inter-knotting*, and it too is occasionally labelled 'the macramé knot.' It is also used in both *clove hitch* and *cow hitch* combinations to suspend the elements from a heading cord. Figure 81 shows this use of the *cow hitch*.

NOTES ON SPECIAL METHODS

SPRANG The possibility of effecting simultaneously duplicated interworking at both ends of a set of elements stretched on a frame has been mentioned in the previous pages, and it was noted on page 62 that this duplicating process appears to be the factor common to the fabrics that have been called *sprang*. It is difficult, however, to verify the limitations of the designation which seems at times to be intended to refer only to so-called 'frame-' or 'loom-plaiting' (*interlinking* of elements stretched on a frame), but at other times seems to indicate combinations of 'frame-braiding' with 'frame-plaiting.' In addition, *oblique interlacing* (*braiding*) and *oblique twining* are also known to have been constructed in the same two-ended fashion on a frame, and it may be that they too are included in the designation *sprang*. I have not, however, been able to confirm the usage. Neither have I been able to determine whether or not the term would be deemed applicable to a fabric in which the elements of a vertical set *interlink* or *interlace* with each other but are also interworked by a horizontal (or weft) set. Nevertheless, regardless of the applicability of the term *sprang*, the two-ended method of handling a set of elements which duplicates the interworking has been utilized for all these structures.

It may well be that the practice of constructing fabrics from both ends at once is much more extensive than is indicated by reported examples of *sprang* and of fabrics described by expressions like 'frame-plaited' and 'loom-braided,' which seem to have much the same connotation as *sprang*. Unfortunately, analysis of fabrics that could have been constructed in that fashion is not an accurate guide to the extent of the practice either, because the evidence of the method is so often indeterminate if not entirely lacking in the fabric.

One of the most characteristic marks of the use of the frame method is the presence of some distinctive structure at the horizontal median line where the constructions from the two ends meet. It may be a structure like that shown in figures 82 and 83 which is formed when the two starting edges are pushed around the end bars to meet at the back of the frame; or it may be one formed by chaining the elements across the fabric to hold the final rows of interworking where the two completed halves meet. (In either case, the two faces of the structure at the meeting point are *dissimilar*, although the two faces of the rest of the fabric are not.) If, in addition to the presence of a distinctive structure, the oblique trend of each element is reversed at the median line, it is reasonable to assume that the duplicating method was used, although the fact that a reversal of diagonals may also occur when each half is constructed separately from the center must still be considered.

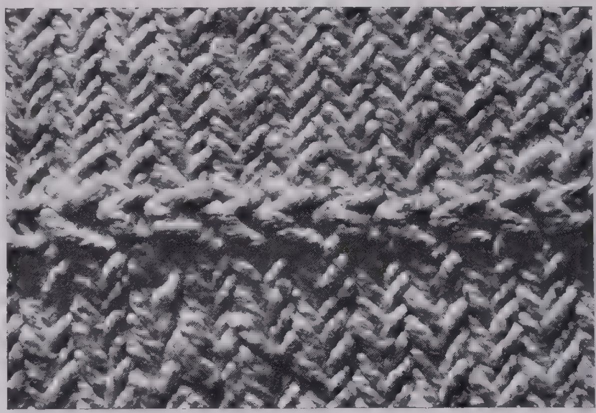

FIG. 82 Structure formed at the juncture of the two starting edges of a 'frame-braided' fabric (detail from a Hopi cotton 'wedding sash').

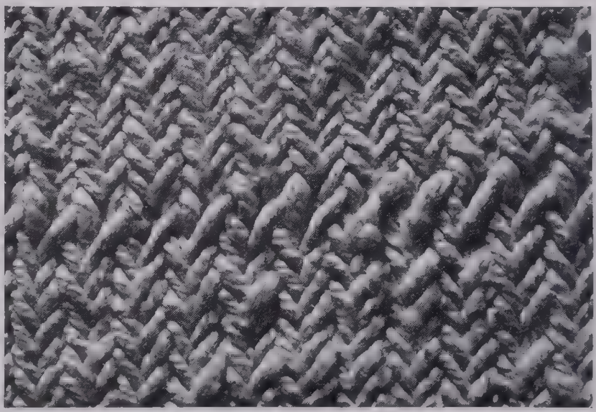

FIG. 83 Opposite face of fig. 82.

Inasmuch as the duplicating method ensures that any structure produced in one half of a fabric is automatically reproduced in the other, a mistake or some peculiarity of structure which is exactly mirrored in the two halves is probably the most conclusive proof of the method available although complete fabrics like the so-called 'ring slings' of Venezuela could probably have been done in no other way. When the method is used simply as a way of producing two lengths of material in one operation, the two will be separated before being used and evidence of the method will be lost.

NOTE: that interweaving a horizontal set of elements (weft) with a vertical set that is itself *interlinked* or *obliquely interlaced* is relatively infrequent, although it may not always be recognized for what it is. When there are definitely distinguishable warp and weft elements, the fact that the vertical elements, contrary to usual warp procedure, interwork with each other as well as with the elements of the horizontal (weft) set is sometimes either not noticed or not considered significant enough to mention (see *transposed-warp weaves*, p. 188).

BOBBIN LACE The construction of *bobbin lace* illustrates a highly refined and elaborately developed use of another special method of handling a single set of like elements that have a common starting point. Constructing a fabric with only *one set of elements* often entails the use of elements much too long and too fine to be easily managed; and furthermore, the greater the number of elements in the set, the greater the difficulty of manipulating them and keeping them in proper order. Stretching the elements on a rectangular frame, or between beams, and using small sticks to maintain successive rows of interworking (as in *sprang*) is one way of resolving the difficulties. Using bobbins or similar devices for winding and weighting each element is another. The use of bobbins eliminates much of the necessity of restricting the length, number, or fineness of the elements. Each element is wound on a bobbin, to be payed out as needed; the small bobbins facilitate the manipulation of fine individual threads; and the weight of the bobbins, by keeping the elements slightly taut, helps maintain their order.

The real extent of the use of devices for weighting and winding each element of a single set is unknown. In the fabric remains of ancient and primitive societies some evidence can be found of the use of small bones to facilitate the braiding of long cords and bands. There are also many ancient fabrics whose size, fineness, and intricacy lead to the conclusion that some special method must have been employed for the complicated handling of many elements. If such a fabric shows no evidence of the use of a frame, it is usually assumed that some method was resorted to that was comparable to the use of bobbins in making *bobbin lace*.

As noted on page 56, the term *bobbin lace* is used primarily to designate one of the two main types of lace-making, that is, to distinguish the kind of lace made with *one set of elements* from that made with one or two *single elements* (i.e. *needle-point lace*). In the refinement and perfecting of the two types of structure, the unique qualities of the fabric type that came to be known as *lace* were steadily enhanced. Implements for making *bobbin lace* became increasingly important as more numerous and more delicate threads were worked into more and more intricate patterns. Bobbins were more and more carefully shaped to provide protection for the fragile threads, and the pillow for the threads to rest on and pins to secure careful definition of design became requisites of *bobbin-lace* making.

Nevertheless the major structures had all been known and used for centuries before they became typical of *bobbin lace*, and presumably the use of something in the nature of bobbins is of similar antiquity. There is, in fact, no very good reason for thinking that the idea of a supporting 'pillow,' into which pins (or thorns or whatever was available) could be stuck in order to simplify the execution of elaborate designs, originated in 15th century Europe.

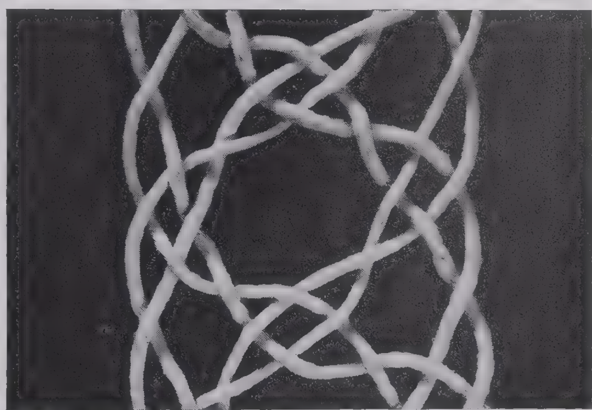

FIG. 84 A simple combination of *oblique interlacing* and *oblique twining* found in both lace and basketry.

Figure 84 shows a very simple 8-thread combination of *oblique twining* and *oblique interlacing* which can be found in this simple form and also elaborated in a variety of ways, not only in the European varieties of *bobbin lace* but in lace-like fabrics of pre-Spanish Peru. The identical interworking is also found used for openwork constructed with the kind of unspun elements, usually somewhat broad and stiff, that are characteristic of basket-work (see pp. 208 ff.).

Notes on the Use of Terms

Interlinking · Plaiting

The ambiguity of the term *plaiting* was discussed briefly on page 60, and a clearer distinction between the meanings of *plaiting, braiding*, and *weaving* was suggested as a way of making it possible to use *plaiting* for precise designation of the type of interworking described as *interlinking*. At present, the term *plaiting* is so commonly used for general reference to any interworking of elements accomplished without mechanical aids, and has, in addition, so many less general but extremely variant uses, that it conveys no exact concept.

A rapid survey of some 50 definitions and explanations of the term reveals that the most common distinction made between *plaiting* and other interworking is based on the premise that *plaiting* is constructed with a single set of undifferentiated elements. This distinction is more or less ambiguously expressed in a variety of ways: 'the elements are all active,' 'the elements are active and passive at different times,' 'no elements are passive,' 'the elements are equal in degree of activity and proportions,' 'the warps and wefts are not distinguishable,' 'it is a technique not based on warp-weft interlacing.' On the other hand, *plaiting* is quite often explained as 'the basketry equivalent of weaving' and the term *weaving* implies at least two sets of elements differentiated in direction if not necessarily in quality.

Differentiation between *plaiting* and *weaving* is variously said to be based on the nature (quality) of the elements, on the absence of a loom, on the oblique rather than parallel relationship of 'both sets of elements' to the edges of the fabric, or on the use of only 'one group of elements' in contrast to the 'two groups' used in weaving. The *sprang* lace-work of Egypt (largely *interlinking*) is commonly called 'Egyptian plaiting,' and we find 'plait-work' referred to as 'the beginning of bobbin lace' and as the 'major mat-making technique' of certain Pacific islands. The term *twine-plaiting* is used to designate both *interlinking* and *oblique twining* as well as to identify *weft-twining* on warp elements (see pp. 200 ff.). In many of these uses the term *plaiting* may only be meant to imply the absence of a loom or any use of implements, but it is hard to be sure.

These few examples of the diversity with which the term *plaiting* is defined and used are enough, perhaps, to demonstrate the importance of greater restraint in appropriating the term for special uses, and the real necessity of making the exact meaning clear whenever it is used. For precise designation of structure, the term *interlinking* is less subject to misinterpretation than *plaiting*, and while it may seem awkward in modified expressions like *spiral interlinking* and *frame-interlinking*, it has the virtue of being reasonably explicit. With either term, clear representation of the structures referred to should accompany description of particular examples.

Braiding · Braids · Sennit · Oblique interlacing

The term *braiding* is obviously subject to some of the same confusion of interpretation as *plaiting*. The two terms are, in fact, peculiarly intermixed in use, although *braiding* is less apt to be used as a general designation of interworking without the use of implements, and is more consistently associated with one-set-of-element constructions. It is more often specifically associated with narrow fabrics than *plaiting* is, and is sometimes defined in terms of limitation of width. However, it is the noun *braid*, rather than *braiding*, that consistently connotes a narrow fabric band or cord (usually not *woven*). The term *braid* can be very well used for general reference to a great number of narrow constructions including innumerable varieties of round- and square-braids, and many *looped, interlooped, interlinked*, and *knotted* structures of similar appearance and use.

Sennit (a word of many spellings, the most common of which are *sennit* and *sinnet*) is usually defined as 'braided cordage,' often as 'flat braided cordage,' but is obviously used for much the same variety of 'braids' described above. In addition, it is sometimes used for warp-weft woven 'tapes,' but there seems no question of its referring to any but narrow constructions. Although both words have nautical associations, it may be that *sinnet* is the form more specifically associated with cordage and *sennit* a variant that has come to be used for more general reference to diverse fiber braids (the narrow straw braids used for making hats, for example).

If all specific association with narrow bands and cords is restricted to the word *braid* (used to name a fabric type, not a structure), *braiding* can be used

to designate both the process and the structure of all *oblique interlacing*. But until and unless the term *braiding* is clearly associated with *interlacing* of a *single set of elements* as contrasted with other forms of interworking, *oblique interlacing* seems to be the only explicit term for the structure.

Oblique twining · *Twine-plaiting*

There are many examples and many varieties of *oblique twining* but the structural type is seldom given a distinguishing name. Examples of it are described as 'braiding with twined (or twisted) threads,' explained as 'similar to bobbin lace,' as 'torchon,' or compared with Saxony lace and the 'stitch' called 'single twist.' A number of varieties of *oblique twining* are used in *bobbin lace*, and as is usual in lace terminology, it is a whole complex of 'stitches' that is named. Any variation, no matter how slight, produces a complex that is given a totally different name that usually offers no hint of any relationship. (For example, completed turns, instead of half turns, of the twining threads between points of interlacing seems to be the sole structural difference between *point de Dieppe* and *point réseau*.)

Twine-plaiting, *twined lace*, and *warp twining* are all terms which have been used, apparently interchangeably, to denote different varieties of *oblique twining*. The ambiguity of the term *twine-plaiting* was pointed out in connection with the diverse uses of *plaiting*. *Twined lace* is less ambiguous but is only applicable to lace-like fabrics. The use of the term *warp twining* for this type of structure is presumably related to the idea that one-set-of-element fabrics are 'composed of warp only,' the one set being, at the start at least, essentially vertical. But we have noted (p. 55) that since *warp*, in its generally accepted sense, refers to a set of elements differentiated in both direction and function from another set (termed *weft)*, it is misleading to use the term *warp* when there is no *weft set* involved. The point is well illustrated by this particular usage, since *warp twining* is a much used and well understood term for the warp-weft structures typical of most tablet- or card-weaving (see pp. 196 ff.).

Sprang · *Frame-plaiting* · *Loom-braiding*

It has been noted that *interlinking* ('plaiting'), *oblique interlacing* ('braiding'), and *oblique twining* can all be done by the two-way duplicating method on a frame ('with stretched threads'). Many words and phrases have been tried out in attempts to distinguish such constructions from similar ones that lack the characteristics peculiar to the frame method. Some of the difficulty is caused by the necessity of indicating both the structure and the distinctive method of construction in the same term. *Sprang* has often been used on the assumption that it implies method as well as structure, but as long as its proper usage is either variable or insufficiently defined, it is wise to use a more specifically descriptive term either in conjunction with *sprang* or instead of it. 'Frame-plaiting' and 'frame-braiding' have been used, sometimes interchangeably, sometimes apparently to indicate two types of interworking. The same is true of 'loom-plaiting' and 'loom-braiding,' and occasionally the uncertainty of the terminology is reflected in an expression like 'frame- or loom-plaiting.' 'Frame-looping' has also been used, the word *looping* intended, perhaps, to express something about the way the elements are manipulated rather than the result of the manipulation. And presumably the use of 'warp twining' for one-set structures refers to frame-constructed *oblique twining*.

In the choice of a word to indicate the 'stretched thread' or 'fixed at both ends' set-up, *frame* seems more suitable than *loom* because it is free of such inapplicable connotations of the word *loom* as the use of heddles. *Frame* is less unwieldy than 'with stretched threads' or 'with threads fixed at both ends,' and also seems slightly preferable to an expression like 'two-way,' perhaps because it specifies the means by which the two-way method is achieved. By using *frame-* to modify a specific designation of the kind of interworking, it should be possible to indicate such a structure and its special method with some precision. But 'frame-plaiting' and 'frame-braiding' remain ambiguous as long as 'plaiting' and 'braiding' are lacking in definition. *Frame-interlinking* may seem clumsier to use than *frame-plaiting*, but it is certainly preferable in view of the over-extended use and resulting indefinite connotations of the term *plaiting*. Affixing *frame-* to *oblique interlacing* is even more awkward, but with no assurance that *braiding* would be recognized as a designation of *oblique interlacing*, it would be better to forgo the use of *frame-braiding* in favor of the more cumbersome *oblique frame-interlacing*. Unfortunately there seems to be no adequate substitute for the equally ungainly *oblique frame-twining*.

Macramé · *Square knotting* · *Inter-knotting*

The term *macramé* is defined and used with surprising consistency in different fields of fabric study and in several languages as well. Definitions in general dictionaries differ little from those in special works on lace, needlework, and rope-work, and the term is in all instances associated with *knotting*. As noted (p. 65), more than one knot may be called the 'basic knot' and more than one may be designated the 'macramé knot,' but there is general agreement about the number and kind of knots employed in the work. The association of the term *macramé* with fringe construction is not a serious handicap to its use, since much of the knotting of a single set of elements is in the form of fringe.

Square knotting, on the other hand, is a somewhat misleading term for the work because it appears to be specifically descriptive but is neither accurately descriptive of this type of knotted work nor as specific as it sounds. To the non-specialist, or to a specialist in another field, the term *square knotting* would apply even better to *single-element knotted netting* made with *square knots* than to this set-of-element type of construction in which the 'square knots,' being tied round 'leaders,' are better known as *Solomon knots*. In addition, we find that the term *square knotting* does not refer solely to *oblique knotting* with *square knots*, but to a general type of work (i.e., 'knotted bar work,' 'knotted fringes,' etc.) regardless of the kind of knot used.

Use of the term *oblique knotting* indicates the relationship of this work to other kinds of oblique interworking but may misleadingly suggest the diamond shaped meshes produced in *knotted netting*. But *inter-knotting* suggests the back and forth interworking of a group of elements, first to one side and then the other, which distinguishes this work from *single-element knotted looping* in much the same way that *interlinking* is distinguished from *single-element linking*.

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PART TWO

Classification of the Structures of Fabrics

I Felted Fibers

II Interworked Elements

- A. Single Element
- B. Two Single Elements
- C. One Set of Elements
- D. Two or More Sets of Elements
  (*see below*)

D. TWO OR MORE SETS OF ELEMENTS

1. Interlacing warps and wefts
   - a. Simple weaves
     - 1). Plain weave
       - Balanced
       - Warp-faced
       - Weft-faced
       - Ribbed
       - Multiple-element units
     - Variant use: *tapestry weave*
       - Slit tapestry
       - Dovetailed tapestry
       - Interlocked tapestry
       - Structural devices for outlining
       - Uses of wedge-like inserts
       - Non-horizontal wefts
     - Variant use: *openwork*
       - Woven-slit openwork

NOTES ON THE USE OF TERMS

Plain weave • *Cloth weave* • *Tabby*
Rib • *Rep* • *Cord* • *Corded*
Basket weave • *Matt weave* • *Half-basket weave*
Weft-faced plain weave • *Tapestry weave*
Slit tapestry • *Kilim tapestry* • *Kilim*
Reinforced tapestry • *Reinforced kilim*
Warp-interlock tapestry • *Interlocked cloth* • *'Patchwork'*

D. Two or More Sets of Elements

In fabrics composed of only *one set of elements*, all the elements are equally, though only relatively, vertical and are interworked with one another; whereas in those composed of more than one set, a series of longitudinal elements, which are essentially parallel to each other, is interworked with another series of parallel elements crossing them at more or less right angles. The longitudinal elements are called *warp*, the transverse elements, *weft*; and at least two sets (one of each) are essential to the structure of a *woven fabric*, or *textile*. A group of elements whose function in a fabric structure differs from that of other elements running in the same direction is regarded as a separate *set of elements*, warp or weft according to its direction.

> *Warp:* essentially parallel elements that run longitudinally in a loom or fabric, crossed at more or less right angles and interworked by transverse elements. (Note that in four-selvedge fabrics, the long dimension is not necessarily in the warp direction.)
>
> *Weft:* the transverse elements in a fabric (generally parallel to each other and to the terminal edges or ends of the fabric) which cross and interwork with the *warp* elements at more or less right angles. (Also called *woof* or *filling*.)

Fabric structures made up of *two or more sets of elements* vary in a number of ways. There are different kinds of interworking (i.e. variety in the nature of the relationship between elements); there are different orders of interworking (i.e. variety in the numerical pattern of the grouping of elements); and there are different degrees and kinds of complexity (i.e. variety in the number and uses of warp and/or weft sets in excess of the necessary two).

Fabric structures composed of only *two sets of elements* are frequently called 'single constructions' because they are made up of one set each of warp and weft elements; but they are more commonly known as *simple weaves* in contradistinction to those having more than the two basic sets, which are referred to as *compound*. *Simple-weave* structures are grouped according to certain characteristic variations in the order, as well as in the kind, of interworking. *Compound* structures are grouped primarily according to the way component sets-of-elements or weaves are related in the fabric structure. In some there is a *simple* (one-warp-one-weft-set) 'ground' or 'foundation' weave throughout, and any additional warp or weft sets are clearly *supplementary*; in others, there are at least two sets of elements in either the warp or the weft direction that are *complementary* to each other and co-equal in the fabric structure; while in still others, the *compound* structure is composed of two (or more) complete and correlative weave structures, either separate but *interconnected* (as in *double-cloth*), or completely interwoven, that is, *integrated*.

Interlacing is the simplest kind of interworking. There is no *interaction* between elements of the same set (their courses run parallel to each other), and elements running at right angles to each other simply inter-cross. But within the limits of this basic simplicity, there are uncounted possibilities of varying the order of the interlacing, and of compounding the structure by the addition either of sets of warp and/or weft or of complete weave structures. The other ways of interworking *two or more sets of elements* all involve inter-element relationships that are structurally more complex. Instead of, or in addition to, *interlacing*, there may be *interaction* between adjacent elements of one set — either a *crossing* and *re-crossing*, with the crossings secured by the *interlacing* of elements of the opposite set, or a *twining* of adjacent elements about each other, enclosing instead of being inter-

laced by elements of the opposite set – or the movement of one set may be a progressive encircling, or *wrapping*, of the elements of the set they intersect, with or without the formation of *knots* to secure each wrapping. But although these interworking relationships are more complex than *interlacing*, their range of variation is comparatively so much less extensive that the *simple* (one-warp-one-weft-set) forms seem adequate to illustrate the principles on which one is distinguished from another and to suggest the possibilities of varying each. *Compound* forms of interworking other than *interlacing* will be illustrated only when some wide-spread use of a structure involves employment of more than the two basic sets of elements (e.g. 'knotted pile,' pp. 221 ff.).

1. Interlacing Warps and Wefts

Interlacing was described on page 62 as "the most straightforward way of interworking elements, inasmuch as each element simply passes under or over elements that cross its path." This applies not only to *oblique interlacing* of the elements of a single set but to *interlacing* of weft with warp elements. *Warp-weft interlacing* is the type of interworking that is characteristic of most loom-woven fabrics, and it has been of major importance in the whole development of *textiles*. The uncomplicated nature of the interworking relationship between elements permits almost endless variation in the order as well as considerable functional differentiation and specialization in the use of elements. It also makes the *interlacing* process peculiarly adaptable to mechanization. It is possible, for example, to effect *interlacing* of *weft* with *warp* by separating the warp elements into two groups (those that are to lie over, and those that are to lie under, a passage of the weft), and, after laying the weft in the opening between the two groups, either reversing or otherwise altering the grouping of the warps for the next passage of weft. Such an opening between groups of warp elements is called a *shed*, and a device for effecting the opening, a *shedding device*.

> *Shed:* a temporary opening between two planes of warp threads selectively separated for passage of the weft.
>
> *Shedding device:* any device (no matter how simple or complex) used to effect a *shed*.

Warp-weft interlacing is straight over-and-under inter-crossing of parallel transverse elements with parallel longitudinal elements. It does not include structures in which elements consistently deviate from their parallel courses to *cross* or to *twine* about other elements of the same set; nor does it include structures in which elements encircle (i.e. *wrap*) those of the opposite set instead of simply *interlacing* them. Slight deviations or *deflections* from the parallel courses that do not involve any *crossing* of elements having the same general direction do not affect the essentially rectilinear quality of a fabric structure.

A. SIMPLE WEAVES

Simple warp-weft structures are those having only one set of longitudinal, or *warp*, elements and only one set of transverse, or *weft*, elements. Variation of structure is effected by varying either the numerical order in which the elements or units of one set interlace with those of the other, the alignment of the interlacings, or both. If the numerical order is over-1-under-1, there can be no variation of alignment and the weave is *plain*. Any other numerical order creates *floats*, and the alignment of floats can be varied in many ways, producing *twill*, *satin*, and other *float weaves* (see pp. 92 ff.).

> *Float:* any portion of a warp or weft element that extends unbound over two or more units of the opposite set on either face of a fabric.

It is characteristic of *simple interlacing* that the structure of one face of the fabric is reflected on the opposite face. No element appears on only one face; and if there are *weft floats* on one face, there are correlated *warp floats* on the other.

NOTE: that if warp and weft elements are dissimilar in size and/or spacing, the correspondence between warp and weft floats may be difficult to detect; but if the order of interlacing is *uneven*, there will be a structural distinction between the two faces whether or not immediately apparent.

1. PLAIN WEAVE

The simplest possible interlacing of warp and weft elements produces *plain weave* (also called *tabby, taffeta weave, linen weave, cloth weave, checker weave*, and so on). The principle of the interlacing is unvarying alternation. Each weft unit passes alternately over and under successive warp units, and each reverses the procedure of the one before it. The warps are separated into only two groups. All warps that lie above one passage of weft lie below the next, above the third, and so on. It is possible to vary the nature of the fabric by modifying the spacing, pliability, or size relationships between warp and weft elements, or by grouping elements into units, without varying the simple alternating order of interlacing which constitutes *plain weave*. The obverse and reverse of *plain weave* are structurally *identical*.

BALANCED PLAIN WEAVE If the warp and weft elements are equally spaced and either identical or approximately equal in size and flexibility, the *plain weave* can be described as *balanced* (fig. 85).

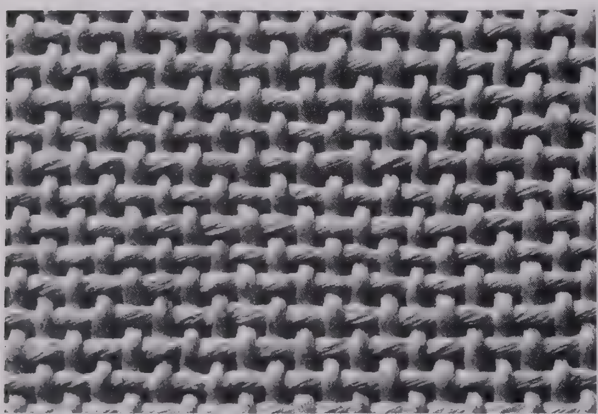

FIG. 85 *Balanced plain weave*, warp and weft equal in size, spacing, and count.

NOTE: that the term *thread count* refers to the number of warp and weft elements to the linear unit of measurement, *square count* to an equal number of each. But the fact that the *thread count* is 'square' does not necessarily mean that the *weave* is *balanced*. If warp and weft differ conspicuously in size, the 'count,' unaffected by the diameter of the elements, may be 'square' but the space between elements will differ in the two sets according to the difference in element size, the bulkier elements lying closer together than the finer ones.

WARP-FACED PLAIN WEAVE The greater the number and the closer the spacing of warp elements in relation to weft, the more the warp will tend to conceal the weft. If the warp elements hide the weft elements completely, the weft will affect the fabric only by its presence, not by its appearance, and the fabric is said to be *warp-faced* (fig. 86). If the warps outnumber the wefts yet do not entirely conceal them, the fabric can be described as having a *predominant warp*.

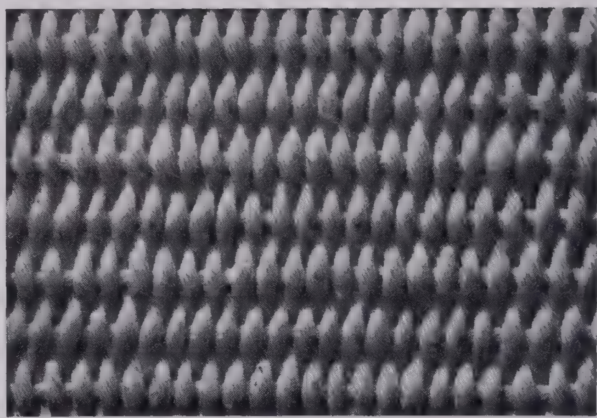

FIG. 86 *Warp-faced plain weave.*

It is obvious that there can be considerable variation in the degree of predominance of warp over weft, and that the line of demarcation between a *warp-faced fabric* and one with a *predominant warp* will always be subject to individual interpretation. However, approximate diameters of threads, given in conjunction with thread counts, will clarify the use of terms in specific instances. (In fig. 86, for example, warp and weft are identical yarns spaced 20 warps x 4½ wefts to the inch.)

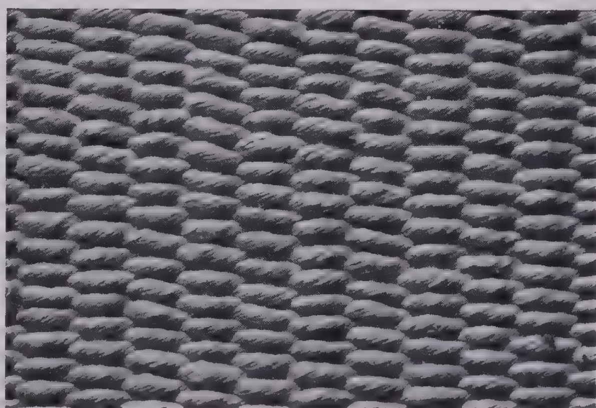

FIG. 87 *Weft-faced plain weave.*

WEFT-FACED PLAIN WEAVE If, on the other hand, the relationship between warp and weft is reversed and the wefts are sufficiently numerous and sufficiently compacted to completely cover the warps, the fabric is *weft-faced* (fig. 87); if the weft obscures but does not conceal the warp, the fabric can be described as having a *predominant weft.*

NOTE: that partial or complete predominance of warp over weft or weft over warp is commonly used as a means of varying texture and quality without weave variation. It is possible in almost all weave structures, and occasional examples will be illustrated.

RIBBED PLAIN WEAVE In *plain weave*, a marked numerical predominance of one set of elements over the other tends to produce a 'ribbed' effect sometimes referred to as *rep* (see p. 86 for discussion of the use of the term). The ribs extend in the direction of the concealed elements. The prominence of the ribs depends on the relative size and spacing of the elements of the two sets. In general, the larger the concealed elements in proportion to the elements that cover them, the more prominent the effect of ribbing; but ribbing can be produced by spacing alone with warp and weft elements that are identical, as are those in figures 86 and 87. The appearance of ribbing is made more pronounced if large and small units are alternated in the hidden set, a characteristic sometimes specifically implied by the use of the term *rep*, or *repp.*

MULTIPLE-ELEMENT UNITS Warp and weft elements are not necessarily used singly as in the illustrations on page 76. The elements of either or both sets can be *paired* (figs. 88 and 89), *tripled* (fig. 90), or used in larger groups — regularly or irregularly disposed (figs. 91 and 92). If identical units are used in warp and weft (figs. 89 and 90) the *plain weave* structure is often called 'basket' or 'matt' weave. If the units of only one set are multiple (fig. 88) the weave is sometimes described as 'half-' or 'semi-basket' (an unhappily indefinite designation since it fails to indicate whether it is warp or weft elements that are multiple). Fabrics which have multiple units in only one direction will not have a balanced appearance although the 'count' (usually of units rather than of component threads) may be the same for both warp and weft. Modifications (predominance of warp or weft, ribbing, etc.) are effected as in any *plain weave.*

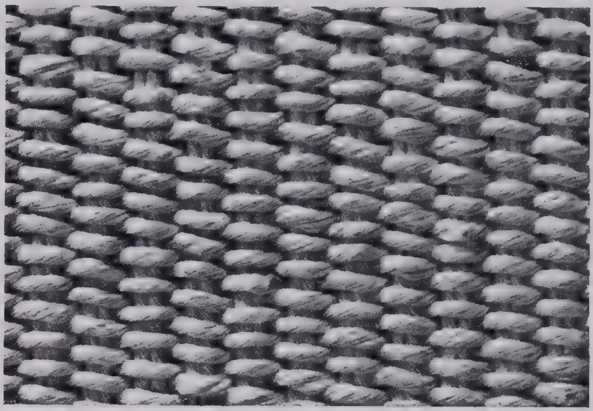

FIG. 88 *Plain weave* with *paired warps* and *predominant wefts* (sometimes called 'half-basket' weave).

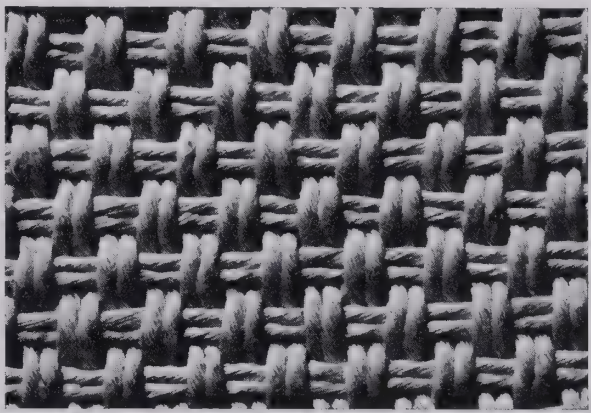

FIG. 89 *Plain weave* with *paired warps* and *wefts* (sometimes called 'basket' or 'matt' weave).

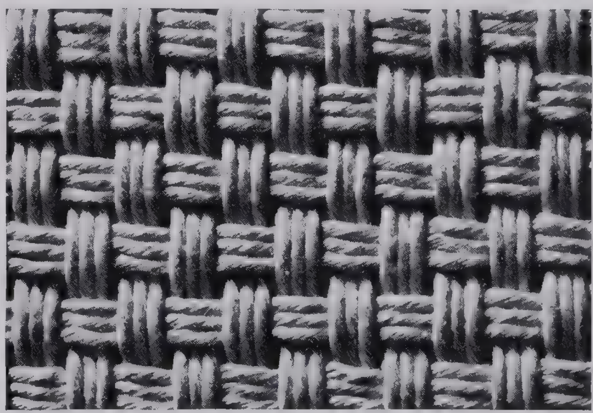

FIG. 90 *Plain weave* with *tripled warps* and *wefts* (sometimes called '3/3 basket' or '3/3 matt' weave).

As long as the same groups of elements are maintained as units, the weave cannot be said to be affected by the number of elements in the unit any more than it is by the size and make-up of elements that are used singly. Elements of either or both sets

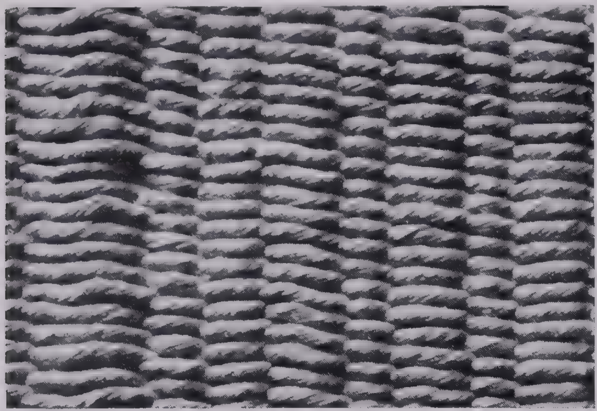

FIG. 91 *Weft-faced plain weave*, with warp units composed of numerically different groups of elements.

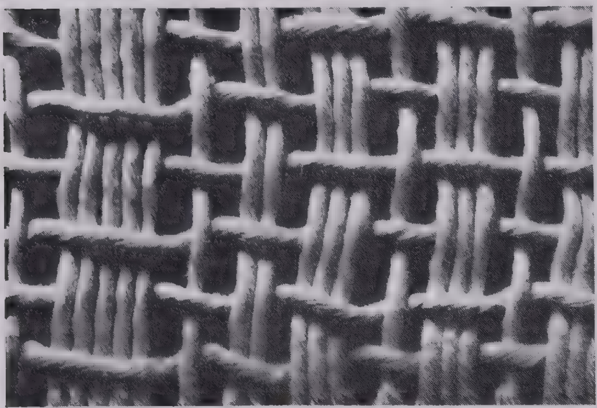

FIG. 92 Diagrammatic construction of fig. 91.

can be grouped in different-sized units arranged in any order desired (figs. 91 and 92). Resulting fabrics may have marked differences in appearance and be called by different fabric names, but a real difference in *weave structure* is only effected by a change in the order of interlacing. If the order of interlacing is constant alternation, the structure is *plain weave*.

NOTE: that most *simple-weave* constructions (i.e. those having one set of wefts interlaced with one set of warps) are subject to all the same modifications of relationship between warp and weft (predominance of one or the other, openness or closeness of weave, grouping of elements into units, etc.) as *plain weave*, with comparable modifications of appearance, texture, and often of fabric name, without variation of the weave structure.

VARIANT USE: *Tapestry weave*

The word *tapestry* is used in many different ways. It may refer to a specific textile technique, to the technique only when used for pictorial patterning, or to such pictorial patterning only when it is designed for mural decoration. Then again it may be used entirely without technical implication — to refer to any pictorial patterning in fabric form. The term *tapestry weave* is also variously defined and applied, but it usually refers specifically to mosaic-like patterning with discontinuous wefts in a *weft-faced* weave (see p. 88).

Areas of solid color are easily produced in any weave in which one set of elements (warp or weft) entirely conceals the other; but in simple weaves, areas of solid warp color tend to be vertical stripes, since warp color is arranged when the warp is set in place and is subject to only slight rearrangement during the weaving process. Weft-wise bands of solid weft color, on the other hand, can be produced at will as the weaving progresses because wefts are interworked one passage ('pick' or 'shot') at a time. A change of weft color that will result in a loom-width transverse color margin only entails substitution of a weft of a different color. If one weft is interworked only part way across the web and others are successively substituted to fill out the row, solid color or texture areas (of easily varied size and shape) can be created by working each weft back and forth in its own area. This simple procedure permits great flexibility in patterning and is the basis of *tapestry weaving*.

Tapestry weaving generally involves two fundamental principles: hiding the warp with closely packed wefts to secure solid color, and weaving independent wefts back and forth each in its own pattern area. *Tapestry weave* is usually *weft-faced plain weave* (and so understood unless otherwise stated) but the same two principles are similarly applied, and mosaic-like patterns of solid color areas similarly produced, in other weaves such as *twill* (e.g. Kashmir 'shawls'), *weft-twining* (e.g. Chilkat 'blankets'), and *weft-wrapping* (e.g. Soumak rugs). Since the principles of patterning are the same, terms like *twill tapestry* and *twined tapestry* are often used to designate these tapestry-like fabrics in other than *plain weave*. When the principle of discontinuous wefts is applied in open or *balanced* instead of *weft-faced* weaves, changes in weft color will still serve to create pattern areas, although muted by unvarying warp color.

In *warp-faced* weaves, patterns of solid color in other than vertical stripes can be produced by a use of discontinuous warps that is analogous to the use

of discontinuous wefts in *tapestry weave*, that is, independent warps of different colors are either knotted together, or interlocked or dovetailed round 'scaffold' wefts, for continuity (see p. 88). When this procedure is combined with the use of discontinuous wefts, the colors are usually correlated so that areas of solid color are produced in balanced or open weaves (see p. 90 for terms for this almost incredible means of obtaining areas of correlated warp and weft color).

Inasmuch as there are few if any wefts that extend the full width of a tapestry-woven fabric, the structural feature that is most significant in distinguishing between varieties of *tapestry weave* is to be found at the meeting point of the wefts of laterally adjacent areas. According to the nature of the connection, or lack of connection, between areas, *tapestry weave* is called *slit, dovetailed* (or *toothed*), or *interlocked.* There are many ways of adapting each type of juncture, and more than one type may be used in a single fabric. In addition, there are structural devices for outlining, inserting small details, and otherwise manipulating simple *weft-faced plain weave* to produce a variety of effects.

The two faces of tapestry-woven fabrics are *identical* in both structure and color patterning, although when weft ends are left hanging instead of being worked into the fabric as other wefts are substituted, the fabric will have definite right and wrong sides. If, as sometimes happens, wefts are carried from one segment of design to others of the same color, nonstructural 'floats' will be formed on the working face; but if the floats are subsequently cut, the structure cannot always be distinguished from one in which the ends were simply left hanging.

SLIT TAPESTRY If there is no structural connection between laterally adjacent areas, that is, if each weft turns back round the marginal warp of its own area (figs. 93 and 94) the fabric is called *slit tapestry.* (For discussion of the use of the term *kilim* in this connection, see p. 89). The lack of lateral connection between areas results in vertical slits along all vertical margins, and the longer the unbroken vertical the more apparent the slit.

Diagonal margins are formed by series of steps, but the diagonal effect may be more marked than that of the verticals and horizontals that produce it and there may appear to be no slits. The length of the verticals in a diagonal boundary is determined by the relationship between the angle of the diagonal and the size and 'count' of warp and weft (i.e. by the number of times a weft turns back around the same warp before the shift is made to the next one). In figure 93, for example, a weft turns back around a given warp only once. If it had been turned round the same warp a second time, the slit would have been longer and the diagonal steeper.

Slits are frequently used for their effect in the design. On the other hand, the structural weakness entailed may be carefully avoided by reduction or complete elimination of verticals in the design, or be partially corrected by sewing up the slits after the fabric is taken from the loom. In any case, as long as there is no lateral interworking between areas in the process of weaving, the structure is *slit tapestry.*

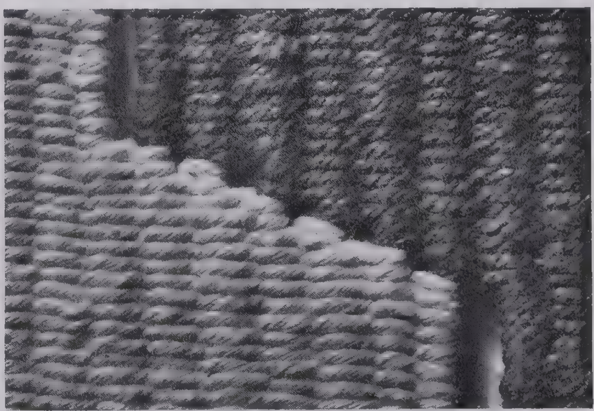

FIG. 93 *Slit tapestry weave*, showing vertical and diagonal boundaries between color areas.

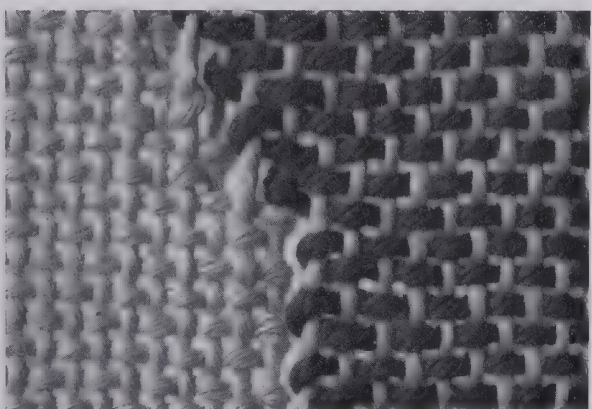

FIG. 94 Diagrammatic construction of the *slit tapestry weave* in fig. 93.

DOVETAILED TAPESTRY No slits are formed if wefts from adjacent areas turn back alternately round the warp which is their common boundary (fig. 96). The alternation of colors along the common warp tends to produce a slightly jagged line of demarcation. The method of joining the areas is described as *dovetailing.* (It should be noted that the term *dovetailing* is used here to denote a structural feature of the boundary between color areas, not a dovetail pattern formed by color areas.) If the wefts are alternated singly, one from one area with one from the other, the dovetailing is described as *single dovetailing*, occasionally as *toothing* (figs. 95 and 96).

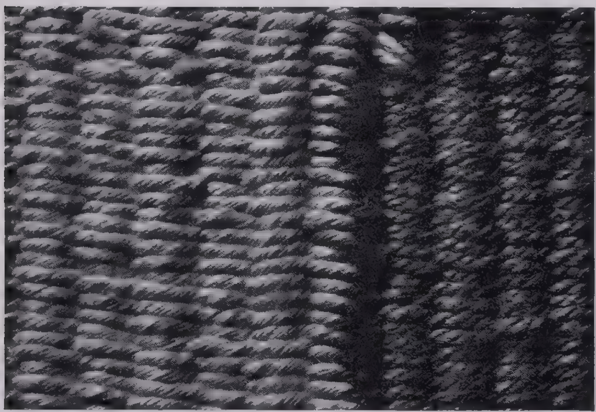

FIG. 95 *Dovetailed tapestry weave* (*single dovetailing*, or *toothing*).

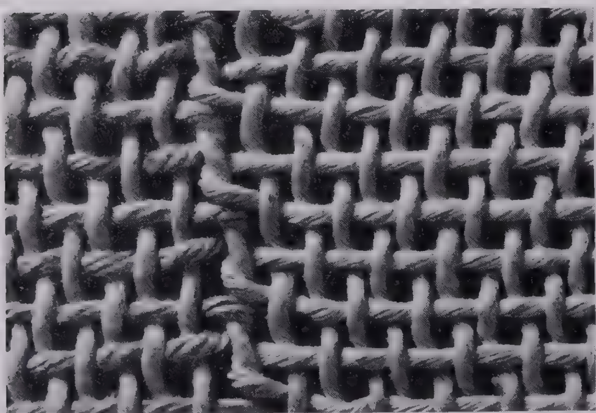

FIG. 96 Diagrammatic construction of the *tapestry-weave* join in fig. 95.

NOTE: that in a less common type of structural dovetailing, wefts from adjacent areas alternately pass into the other area. They turn on adjacent warps instead of turning alternately on a common warp. This is sometimes referred to as an *interpenetrating* type of *dovetailing*.

When wefts from adjacent areas alternate two or more at a time round a common warp (figs. 97 and 98) the appearance of dovetailing is more marked. The grouping can be specified as *2/2 dovetailing* (figs. 97 and 98), *3/3 dovetailing*, and so on.

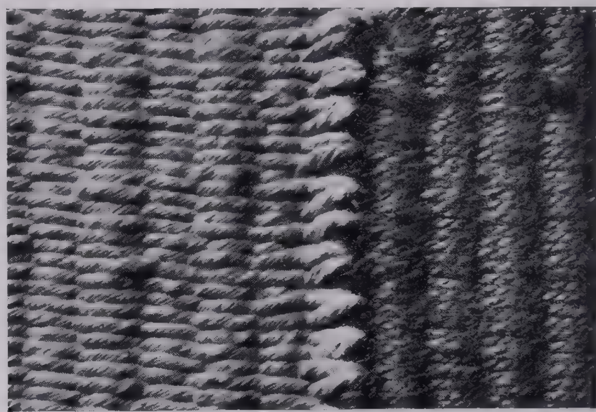

FIG. 97 *Dovetailed tapestry weave*, showing 2/2 grouping of wefts.

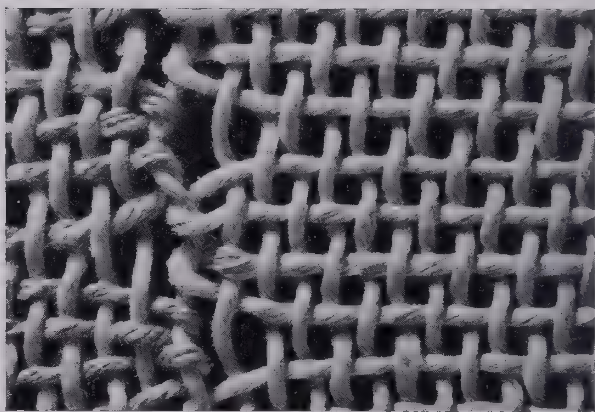

FIG. 98 Diagrammatic construction of the *tapestry-weave* join in fig. 97.

INTERLOCKED TAPESTRY Another way of joining areas without forming slits is by *interlocking* the wefts, that is, by linking the wefts of adjacent areas with each other each time they meet. This is known as *single interlocking* (figs. 99 and 100). The wefts usually link between warps (as shown in fig. 100) and the term *interlocking* is construed as *single interlocking between warps* unless otherwise stated. There is, however, a less common type of 'join' characterized by wefts which are carried round a common warp as in *single dovetailing* and simultaneously linked with each other. This is usually described as *interlocking round a common warp.* It is often difficult to distinguish from *dovetailing* if the weaving is compact.

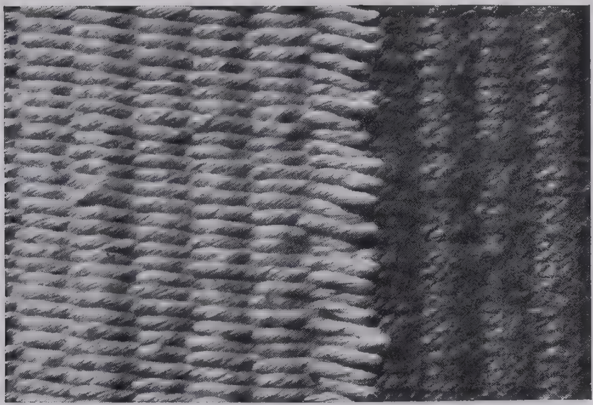

FIG. 99 *Interlocked tapestry weave (single interlocking).*

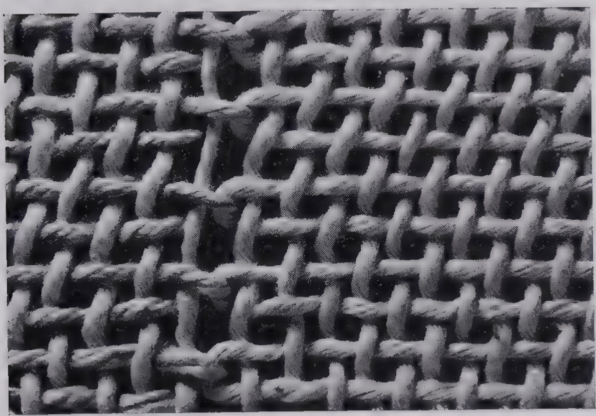

FIG. 100 Diagrammatic construction of the *single interlocking* in fig. 99.

In *single interlocking,* wefts link once each time they pass *back and forth.* If, instead, they are linked at each passage – once as they move from left to right and again as they move from right to left – the *interlocking* is called *double* (figs. 101, 102, 103, 104).

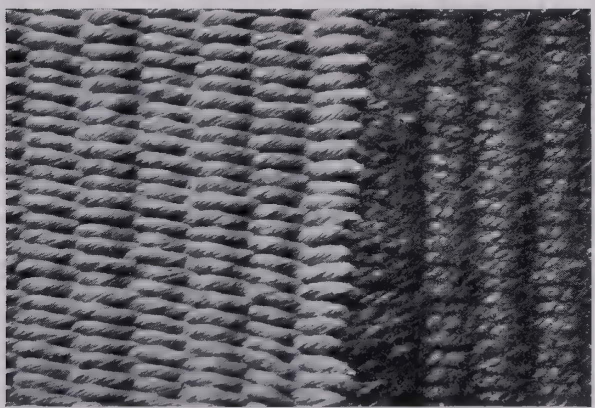

FIG. 101 *Double interlocked tapestry weave* (obverse).

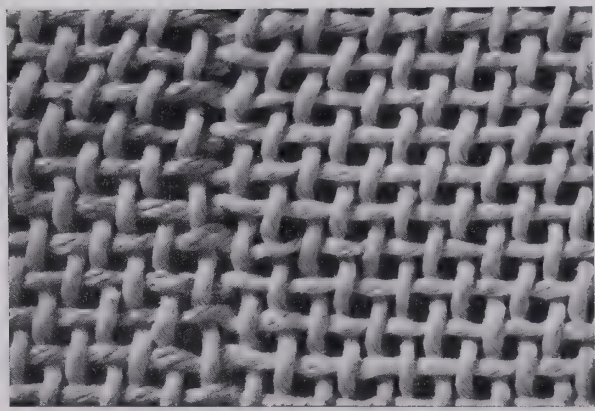

FIG. 102 Diagrammatic construction of the *double interlocking* in fig. 101.

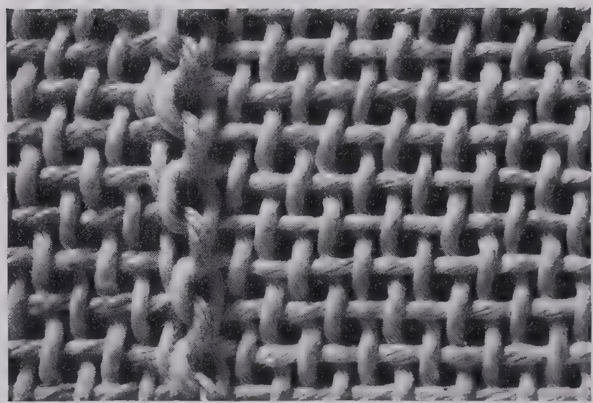

FIG. 103 Opposite (working) face of fig. 102; diagrammatic construction of fig. 104.

Double interlocking (sometimes identified as '*Swedish*' or '*two-way*') is one of the few *tapestry-weave* structures with *dissimilar* faces. Each color appears in the other color area (fig. 104) and a marked ridge is produced on the working face of the fabric (fig. 103).

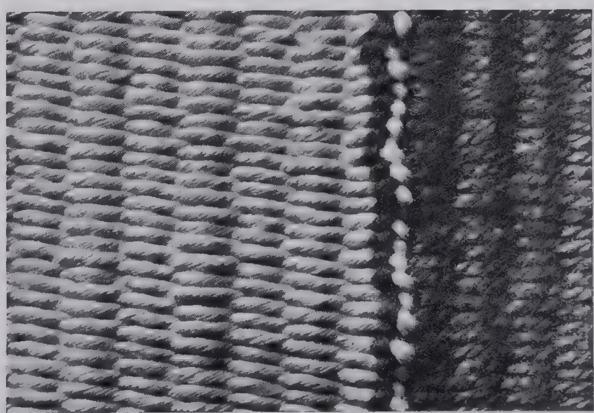

FIG. 104 *Double interlocked tapestry weave* (opposite face of fig. 101).

STRUCTURAL DEVICES FOR OUTLINING In any flat-color patterning, outlining the color areas serves to define the shapes and keep the colors distinct. In *tapestry weave*, an area can be outlined by interworking a contrasting weft in such a way that it follows the shape of the margin instead of the usual horizontal weft course. A single outline weft interlaced with the regular warps along a margin will form a dividing line of color when the wefts are beaten down to cover the warps. An additional weft following the alternate order of interlacing will make the outline more solid. Further increase in the number of outline wefts will add emphasis to the line.

A solid outline can be formed by a single weft that is progressively 'wrapped' over two warps and back under one. This constitutes a deviation from the *plain weave* of tapestry and is *dissimilar* on the two faces. The obverse (fig. 105) is the counterpart of *stem stitch*, the reverse (fig. 106) of *back stitch* (see pp. 238 f.).

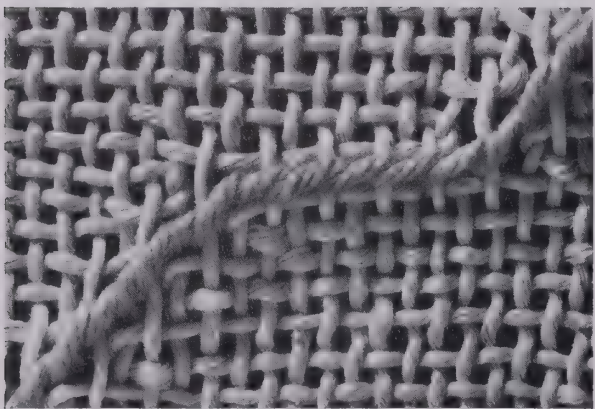

FIG. 105 Diagrammatic construction showing diagonally and horizontally *wrapped outline weft*.

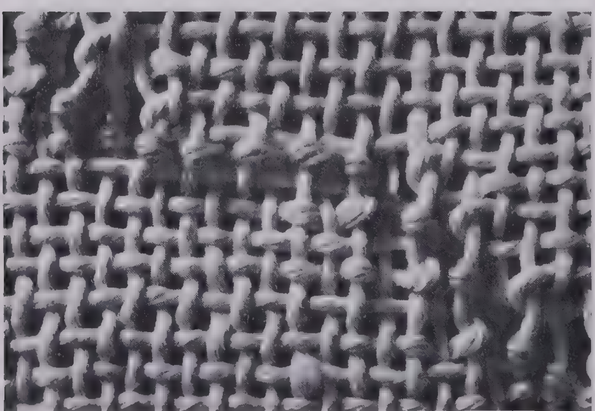

FIG. 106 Opposite face of fig. 105.

Outlining a vertical margin presents a somewhat different problem. It has been solved in various ways. For example, an outlining weft may be laced back and forth between the marginal warps of adjacent areas (fig. 107). This constitutes a kind of *dovetailing* and serves the dual purpose of avoiding formation of a slit and of outlining a margin. An outlining weft used in this way may be difficult to distinguish from a sewing thread used to close a slit after weaving. Other joins and outlines in the same fabric may provide a basis for making the distinction.

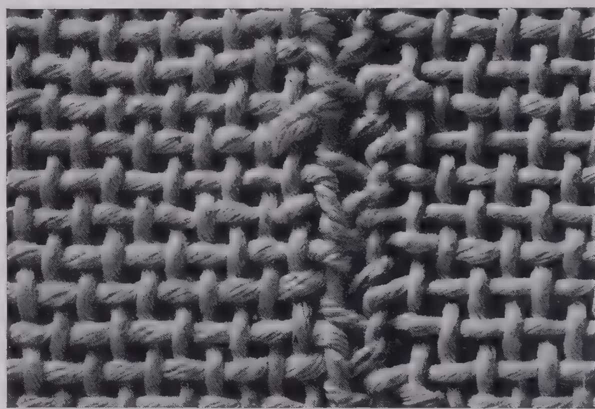

FIG. 107 Diagrammatic construction of a vertical margin closed and outlined by a lacing, *dovetailing*, weft.

An outlining weft, interlaced on two warps that lie between two areas but are not included in either, will form a solid grooved column detached from both areas – usually for the length of the vertical margin. A column of similar appearance but ungrooved is produced by winding an outline weft round and round one or more intermediary warps.

USES OF WEDGE-LIKE INSERTS A practical device for straightening the line of weft passage when the working edge of the fabric has become uneven in the course of weaving has been noted in early *plain-weave* fabrics from widely separated areas of both the Old and the New World. It consists of turning a weft back where an area needs filling in and working it back and forth in that area before completing its passage. If the fill-in requirement is considerable, the working back and forth will form a wedge-shaped area round which the regular weft passages will curve slightly. If a weft is worked back and forth in this way only once, the deviation in the weave is slight and not really wedge-like in appearance although the principle and purpose are the same. The

use of this device seems to be associated with simple and probably somewhat crude loom construction. It has been noted chiefly in *plain-weave* fabrics of relatively balanced construction or with predominant warps. It would be neither noticeable nor particularly noteworthy in *tapestry weave*, since tapestry wefts are customarily worked back and forth in limited areas and may even be turned back within a color area as a matter of convenience in working (creating diagonal markings sometimes referred to as 'lazy lines').

Whether or not this device for straightening the weave suggested the use of a similar device for decorative purposes can only be conjectured, but small isolated areas of color are often worked into larger fields in much the same way. A separate weft is worked back and forth in a small area and lies between two regular passages of the weft of the larger area (fig. 109). Closely beaten up, the wefts of the larger area will adjust themselves round the insert and be thrown slightly out of line by it (fig. 108).

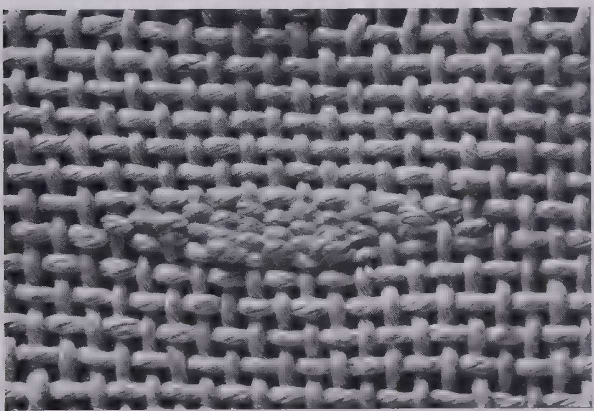

FIG. 108 Wedge-like insert woven between two regular weft passages.

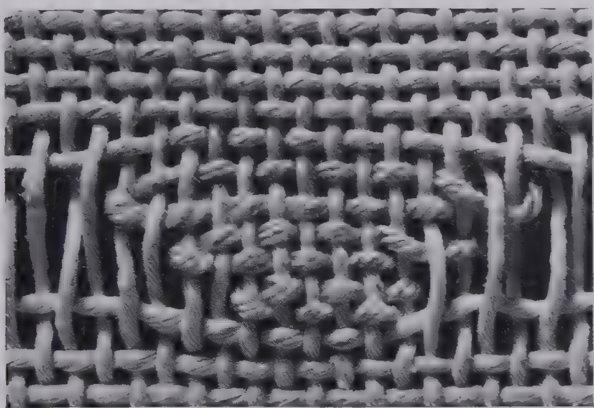

FIG. 109 Diagrammatic construction of the wedge-like insert in fig. 108.

NON-HORIZONTAL WEFTS The non-horizontal use of wefts for outlining and the possibility of weaving 'wedges' and other inserts suggest that part of the unusual flexibility of *tapestry weave* is due to its relative freedom from a rigidly rectangular relationship between warp and weft and to the ease with which the density of the wefts can be controlled and varied without varying the weft-faced quality of the weave. We have seen that either wedge-like or linear inserts can be used to counteract unwanted unevenness of weft density, and that weft density can be intentionally varied to make similar inserts for decorative purposes. One of the most notable results to be achieved by manipulation of weft density is the creation of truly curvilinear figures — not just the curved effects that are produced, in strictly rectangular interlacing, by fine gradations of the density and compass of the weft. In successive passages a weft being used to form a curved figure deviates more and more from the normal horizontal to follow the developing contour. If carried to an extreme, as it sometimes is, this produces color areas that in addition to being curved in outline are rounded out slightly from the plane of the fabric (fig. 110).

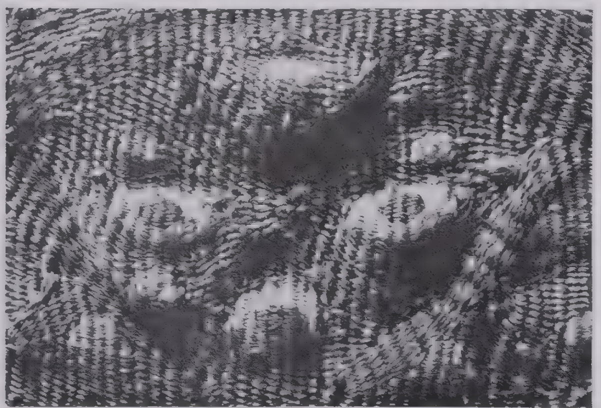

FIG. 110 Exaggerated use of *non-horizontal* or *eccentric wefts*. (Detail of tapestry-woven panel from Peru, T.M. 91.146.)

Wefts that deviate from the horizontal and from their normal right-angled relation to the warps are usually referred to as *eccentric wefts*. There are instances, however, of restriction of the use of the term, sometimes to outline wefts, sometimes to wefts used for curvilinear figures. The structure of a tapestry-woven fabric characterized by the 'eccentric' use of wefts for figuring is sometimes referred to as 'eccentric tapestry' or 'eccentric weave.'

NOTE: that the extent to which warps are drawn out of their vertical alignment by the use of eccentric wefts is seldom commented on, probably due to the fact that in tapestry the warps are not visible. However, an example of extreme divergence has been noted in an uncommon variety of Navajo 'blanket' usually described either as 'wedge-weave' or 'pulled-warp weave.' Zigzag patterning (or 'lightning design') is produced by the use of eccentric wefts interworked along the diagonals of the pattern instead of by the customary use of horizontal wefts in stepped series. The warps are 'pulled' out of line and the side edges of the fabric become scalloped in the process. This could well be called 'an eccentric weave.'

VARIANT USE: *Openwork*

Normally, in warp-weft interlacing, wefts progress without interruption across the warp. However, we have seen that it is quite possible to use discontinuous wefts (to produce shaped areas of solid color in *tapestry weave*, for example) and also that the normal weft movement can be interrupted and modified to form inserts of various shapes, sizes, and uses. When wefts are continuous but the weft movement is reversed from time to time, each weft eventually progresses entirely across the warp but only after turning back on itself at some point, proceeding for a space in the opposite direction in the opposite shed, and again turning to advance in the original direction and original shed.

Repeated and regulated, this meander-like weft movement — forward, back, and forward again — can be used to produce modifications of texture and appearance in *plain weave*. The modifications are usually characterized by the openwork effect that accompanies the repeated changes in weft direction, and by the deviation of both warp and weft from their respectively vertical and horizontal courses (fig. 111). Both the laciness of the weave and the degree of deviation of the warp and weft are affected by a number of variables: the relative sizes of warp and weft, the spacing of the warp, the tension of the weft, weft density, and the arrangement of the weft turns.

It is usual for the wefts to be turned back on the same warps either in successive passages (fig. 113) or in alternate passages (figs. 111 and 112). The effect of the former is vertical ordering of the openings; whereas the latter may seem almost haphazard although the meander-like course of each weft is the same.

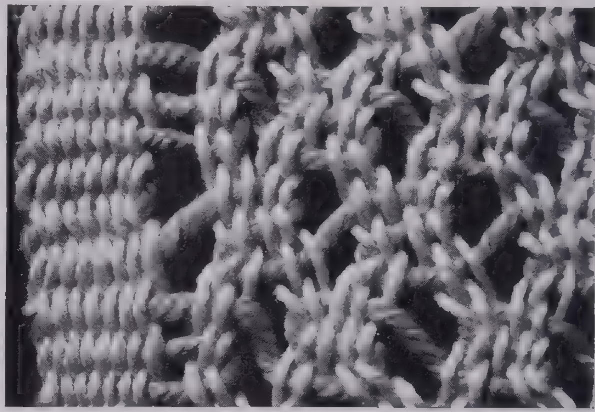

FIG. 111 *Plain-weave openwork* produced by repeatedly turning back the weft — showing alternation of turning points and considerable deviation of both warp and weft courses.

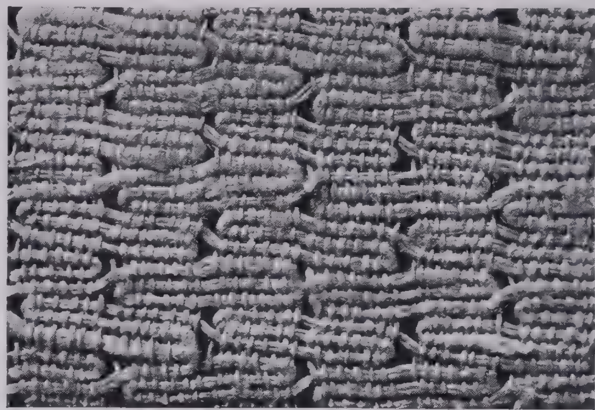

FIG. 112 The same *plain-weave openwork* structure as in fig. 111, with closely compacted wefts, alternate turning points, and little warp deviation.

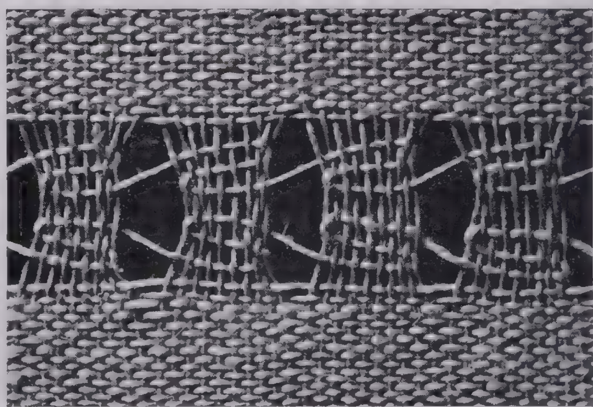

FIG. 113 Band of *plain-weave openwork* formed by two weft passages with no change of turning points.

Such *plain-weave openwork* is often used for decorative bands (fig. 113). More extensive patterning can

be produced, as in most openwork, either by means of shaped areas of openwork in a close-worked weave or by patterned arrangement of the openings.

The technique is more often described than named. It is probably best known for its use in Spanish linen weaving (down to the present time) and in pre-Spanish Peruvian weaving. It is called 'Spanish lace,' 'Spanish eyelet,' 'loom-made lace,' '*red de telar*' (loom net), 'Moorish weaving,' and so on, all very general terms and all equally applicable to quite different structures. The term *plain-weave openwork* identifies both the weave and one of the outstanding qualities of this particular use. It fails, however, to specify the meander-like weft movement by which it is produced, as distinguished from the use of discontinuous wefts for openwork formed of 'woven slits' (fig. 114).

WOVEN-SLIT OPENWORK The use of separate wefts to weave a pattern of openings is so clearly related to the use of separate wefts in tapestry weaving that openwork formed of 'woven slits' (fig. 114) is often referred to as 'tapestry-woven openwork.' However, inasmuch as such openwork patterning seldom involves color changes and is often warp-faced or nearly so, the use of the term *tapestry* in connection with it is misleading (see p. 89 for further discussion). The term *woven-slit openwork* would apply to any utilization of discontinuous wefts to form organized arrangements of openings.*

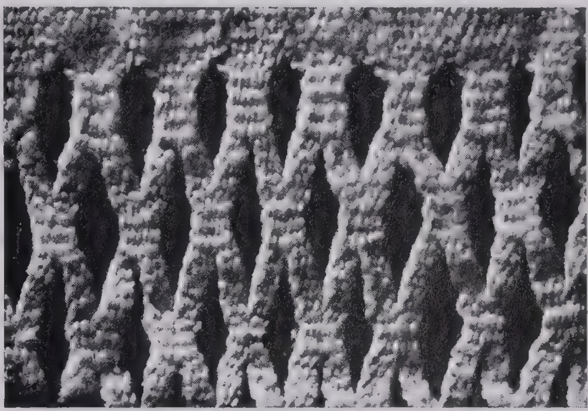

FIG. 114 One type of openwork patterning in *plain weave*. The openings are 'woven slits' effected by means of discontinuous wefts. (Detail of cotton fragment from Peru, T.M. 91. 710.)

NOTE: that the term *weft-wrap openwork* specifically describes the distinguishing and deviant characteristic of still another use of *plain weave* for openwork — a special use apparently peculiar to pre-Spanish cultures of the American Southwest (see p. 217).

Notes on the Use of Terms

Plain weave · *Cloth weave* · *Tabby*

Inasmuch as *plain weave* is the simplest possible form of warp-weft interlacing, there is nothing surprising about the extent and variety with which it has been utilized in all periods and areas of textile production, or the consequent multiplicity of its 'names.' Bearing in mind the fact that a large proportion of the utilitarian fabrics of any particular time and place are likely to be *plain woven* (no matter how much they may vary in textural quality or fiber content) it is possible to imagine ways in which each of many different terms may have come to be used to refer to *plain weave*. It is not possible, however, to justify continued use of many different terms for precise designation of the *plain-weave* structure.

We may presume, for example, that use of the term *linen weave* for *plain weave* reflects the commonness of plain-woven linen cloth at some particular period in some particular part of the world, and the term *cotton weave* a similar use of cotton somewhere else. At first the name of the fiber may have been used to identify the cloth and later, since the weave was always the same, to refer to the weave itself. (For other structures termed *linen weave*, see p. 125.) In other instances, names of fabrics now or at one time characterized by a *plain-weave* structure have been used to name the characteristic weave. *Calico-*, *muslin-*, *canvas-*, *gingham-*, *taffeta-weave*, and possibly *tabby* are examples of this kind of transfer of terms.

Use of the word *cloth* for the *plain-weave* structure may have resulted from the practice of referring to all simply woven fabrics as 'plain cloth' or 'plain woven cloth.' In time apparently some dropped the

word *plain*, others the word *cloth*, and we find the terms *cloth weave* and *plain weave* identically defined, although *plain weave* is much more widely used than *cloth weave*. The word *cloth* is ordinarily defined, and used, in certain other ways: in a broad sense, to refer to any fabric – woven, felted, or otherwise constructed – of any variety of filament or fiber; or restricted to woven or 'textile' fabrics as distinguished from non-woven. It sometimes refers only to fabrics woven of wool (usage apparently limited to 'trade' or commercial terminology) and sometimes only to fabrics woven in *plain weave*. As a definitive term for the plain-weave structure, its use is both limited and specialized.

In contrast to the terms that seem to derive from certain well-known uses of *plain weave*, there are terms that seem to be descriptive of its appearance. The term *checker weave*, for example, may derive from basket- or mat-weaving terminology and be meant to describe the appearance of relatively broad flat elements interworked in *plain weave*. On the other hand, it may be that the term was suggested by the appearance of the alternating light and dark squares with which the textile designer designates *plain weave* on graph paper. However, to the extent that the term is suggestive of appearance, it is inappropriate to many *plain weaves*. Consequently, it is not really suitable as a general designation of the structure.

As already suggested, use of the term *tabby* as a designation for *plain weave* may represent a simple transfer of designation from a fabric to its weave structure, since *tabby* was once the name for a plain woven silk – a 'striped taffeta' – and later a name for 'watered' taffeta. The word apparently has a number of associated connotations. A check of translations of textile references to *tabby* and of foreign language textile equivalents indicates considerable unanimity of association with the idea of 'watered' silk or 'flecked' or 'watered' marking of some sort, occasional association with the calendering process, and with the general idea of 'ancient silk fabrics.' (Note the French *tabis* and *tabiser*, the Italian *tabì*, the Spanish *tabí*, and the German use of *moiré*.)

It is difficult to determine just when and in what connection *tabby* came to be used as a synonym for *plain weave*. There may be earlier references to the usage, but at least as early as 1910 *tabby* was defined in the glossary of Luther Hooper's *Hand-loom Weaving* (Hooper, 1910, p. 329) as "plain weaving," although a little later in the *Dictionary of Textiles* (Harmuth, 1915, p. 150) it was defined as "the British equivalent of moire." The *Dictionary of Textiles* may represent American industrial usage of the time and *Hand-loom Weaving*, British handcraft usage; and one may represent more widely accepted usage than the other. In any event, *tabby* has achieved fairly wide acceptance, especially in the terminology of hand-weaving where it is used both as a synonym for *plain weave* and as a term for specifying *plain weave* used as a 'ground' weave. (Note reference to 'a tabby shot' as distinguished from a 'pattern shot,' for example.) But it is noteworthy that even in hand-weaving terminology *tabby* is almost never used without at least parenthetical reference to *plain weave*, whereas *plain weave* is widely used in the terminology of various special textile fields with only occasional reference to *tabby* as a synonym.

Use of *taffeta* (or *taffeta weave*) as an equivalent of *plain weave* is not common, and usually when it is used to specify a weave rather than a fabric the term refers only to *balanced plain weave*. The argument for using it for reference to a weave structure is based on the French *taffetas* and the equivalent and related terms in Spanish (*tafetán*) and Italian (*taffetà*). It should be noted, however, that these terms are usually considered terms for *plain-weave* silk only; other terms are used for the same weave in other materials.

Rib · Rep · Cord · Corded

There is great variety in the terms employed to designate ribbed fabrics or fabric structures; and there is equivalent variety in the definition and application of each of the numerous terms. *Rib*, *rep* (*repp*), and *cord* are probably the ones in most common use, but *poplin*, *piqué*, *canalé* (*canelé*, *canilé*, etc., with or without reference to the meaning of the French term *cannelé*), and others are also used – often quite indiscriminately. *Rib* and *rep* are both widely used (often interchangeably) as generic terms for ribbed textiles, regardless of the direction of the ribbing or the exact nature of the weave. But at the same time *rep* has been used to designate specifically a *warp-faced plain weave* fabric (whether or not it is characterized by transverse ribbing); and this use of *rep* may be in part responsible for the unfortunate use of the term *tapestry*, not with its full meaning but as the opposite of *rep*, for any *weft-faced plain weave*.

The distinction between vertical and transverse

ribbing is usually made by prefixing *warp-* or *weft-* to the term *rib* (or *rep*). *Warp-* and *weft-* distinguish two directions of ribbing, one perpendicular to the other, but which one refers to vertical ribbing and which to horizontal depends on which of two contradictory usages happens to have been chosen. *Warp-rib* (or *warp-rep*) may refer to a *weft-faced* fabric with ribbing in the warp direction (i.e. the concealed warp elements form the ribs); but it is used quite as often to refer to the opposite construction, a *warp-faced* fabric in which the ribs are covered by the warps not formed by them. Use of *weft-rib* and *weft-rep* is marked by analogous contradiction, and we are forced to the conclusion that prefixing *warp-* or *weft-* to *rib* or *rep* is not sufficient to denote the direction of the ribbing. The expressions *warp-wise* (or *vertical*) *ribbing* and *weft-wise* (or *horizontal*) *ribbing* clearly specify rib direction; *warp-faced ribbing* and *weft-faced ribbing* are not as specific but imply the rib direction without danger of confusion since, as noted and illustrated on pages 76 to 78, it is the concealed element that forms the rib.

However, inasmuch as there are many other ribbed fabric structures besides those of *plain weave* whose ribbing results from the relative size and spacing of warp and weft elements, precise description requires identification of weave structure as well as of rib direction. Thus *warp-faced plain weave* describes a particular structure (*plain weave*) and type (*warp-faced*). Reference to a *warp-faced plain-weave rib* or to a *ribbed fabric of warp-faced plain weave* adds the information that ribbing is a noteworthy characteristic of the material, and the weft-wise direction of the ribbing is implicit in the warp-faced quality of the fabric. As long as the terms *weave* and *warp* (or *weft*) are included in the designation there should be no danger of 'rib' or 'ribbed fabric' being mistakenly construed as a reference to a *single-element* structure like *knitting* or to any form of oblique interworking of a single set of elements.

It should be noted that the term *rep* has been used and defined in so many different ways that it is almost devoid of meaning. To the extent that it is defined as synonymous with *rib*, there seems no reason to use it instead of *rib*; to the extent that it implies ribbing, it is inappropriate as a designation for *warp-faced plain weave* which may or may not have definite ribs. It does not designate a specific weave structure but could be used effectively as a term with which to identify any deliberately planned ribbing created by an organized combination of elements of unequal size or by a special weave structure.

Oblique interlacing (or *braiding*) that is characterized by ribbing has been variously termed 'rep braid,' 'ribbed braid,' 'corded braiding,' and so on. Although sometimes used as a synonym for *ribbed* or *rep*, the term *cord* (or *corded*) may have enough less association with the idea of a *warp-weft interlacing* to be a somewhat less confusing term with which to describe the diagonal ribbing that is sometimes produced in *oblique interlacing* (*braiding*) or in *oblique twining*. (See p. 206 for use of *corded* in reference to *warp-* and *weft-twining*.)

Basket weave · Matt weave · Half-basket weave

Webster's New International Dictionary (1950) defines *basket weave* as "A style of weave in which the pattern has the appearance of a plaited basket. It is produced by the interlacing of double threads." The definition presents the common concept of the weave and suggests the descriptive significance of 'basket' (and by analogy, of 'matt') in the terminology of loom-woven fabrics. The term *basket weave* is more common in this country; *matt weave* seems to be the British equivalent. Both terms probably came to be used because the effect of several parallel elements acting as a unit suggests that of the relatively broad flat elements often used in baskets and mats.

The term *basket* (and perhaps *matt*, as well) has been applied to other weaves (twill, for example) when multiple-element units are employed. But the implication of multiple-element units has frequently been detached and substituted for the whole concept of "the appearance of a plaited basket" and "the interlacing of double threads." This has led in turn to the use of such expressions as 'half-basket,' 'semi-basket,' and 'incomplete basket weave' to denote the use of multiple units in one set but not in the other. Terms which indicate multiple units in only one set must always be amplified by specific indication of which elements (warp or weft) are multiple and which single; and, as is true of the terms 'basket' and 'matt,' they must be accompanied by a designation of the number of elements that compose the units.

Such designations as *3/3 basket weave* and *4/4 matt weave* would have significance as terms of structure only if the terms *basket weave* and *matt weave*

were generally and clearly understood to be restricted to *balanced plain weave* constructions. But present usage does not indicate any general acceptance of the restriction. Furthermore, the implication of the term would not be applicable to the so-called 'half-basket' weaves inasmuch as they seldom have a balanced 'count' and, by nature, never have a balanced appearance. It is necessary not only to specify which set of elements is composed of multiple-element units, but to indicate any predominance of one set over the other. However, instead of assuming that the term *basket* in the expression *2/2 basket weave* will be interpreted as a *balanced* construction with *plain weave* interlacing, it is possible to describe the structure comprehensively as a *balanced plain weave* with *paired warps and wefts.* Even when there are multiple units in only one set and the weave is not a balanced one, description need not rely on assumptions and interpretations since a structure could be described specifically as, for example, '*plain weave* with *paired warps* and *predominant wefts*.' As long as the usefulness of *basket* and *matt* as definitive terms of structure is questionable, it would be more practical to use them to describe (but not to designate) weaves designed to imitate the effect of basket-work, including those now somewhat hazily referred to as 'pseudo-basket' or 'false basket' weaves.

NOTE: that the word *extended* is occasionally used in conjunction with the name of the weave of a fabric to indicate that the elements in either the warp or the weft direction (or both) are either paired or multiple.

Use of the term *hopsack weave* as a synonym for *basket weave* illustrates again the custom of borrowing the name of a fabric and using it as a term for the weave that is typical of the fabric. *Monk's cloth* is the name of another common present-day example of the same weave (although sometimes applied only if the warps and wefts are quadruple). The name *monk's cloth,* however, is rarely used for the weave itself, although the fabric is frequently referred to as an example of the weave.

Weft-faced plain weave · Tapestry weave

The practice of adopting and redefining a specific term for generalized use beyond the limits of its usually accepted meaning is exemplified by the extension of the meaning of the term *tapestry* (or *tapestry weave)* to include all *plain weaves* that have wefts that are numerous and compact enough to completely conceal the warps, whether or not the weave is also characterized by the use of discontinuous wefts for patterning. In this generalized sense, connoting only the *weft-faced* concealed-warp characteristics of a weave, the use of the term *tapestry* is sometimes extended to include *twill* as well as *plain weave.* These somewhat arbitrary extensions of meaning have created considerable confusion and have led, among other things, to use of the seemingly self-contradictory expression 'monochrome tapestry.' One of the few structures which might justify the expression 'monochrome tapestry' would be one in which discontinuous wefts are used to create a pattern composed entirely of woven slits. But if this involves some compacting of the warps (drawing them out of their vertical alignment) it tends to make the warp predominate over the weft and the term *tapestry* proportionately inappropriate. Nevertheless this use of woven slits is often referred to as 'tapestry-woven openwork' (see p. 85).

Inasmuch as there is above average agreement on the use of the term *tapestry weave* for a definite complex of characteristics, it seems important to retain its association with the characteristics that distinguish the complex, as well as with the whole complex. *Weft-faced plain weave* identifies the weave when it lacks the special characteristic of discontinuous-weft patterning. It is when that characteristic is added that *weft-faced plain weave* becomes *tapestry weave.* Similarly, the term *weft-faced twill* identifies a weave which, if used for the discontinuous-weft patterning of *tapestry* weaving, can be quite properly identified as *twill tapestry* (see pp. 106 f.).

NOTE: that although seemingly impractical and obviously involving a more complex procedure, pattern is sometimes produced in a *warp-faced plain-weave* fabric by using discontinuous *warps* to effect changes of *warp* color. In ancient Peru and presumably for related structures found elsewhere (e.g. Coahuila, Mexico) so-called 'scaffold' or 'skeleton' wefts were used as a framework of horizontals round which limited-length warps of one color could either be 'dovetailed' or 'interlocked' with those of another, a technique often described as 'warp interlock' (v.i.); while on certain Micronesian islands (Kusae, for example, and Ponape) a similar result is achieved by 'knotting in' lengths of different colored warps as required for the projected pattern.* The analogy between any such patterning by means of discontinuous warps and the discontinuous-weft patterning that characterizes *tapestry*

weave may seem to justify this one use of the always equivocal expression 'warp tapestry,' but any other use – for any other kind of warp patterning – is wholly unwarranted.

Association of the name *Gobelin* with the word *tapestry* as a result of the fame of the pictorial mural tapestries made in the Gobelin workshops undoubtedly explains the occasional use of the expression 'Gobelin weave' to refer to *tapestry weave*. However, unless 'Gobelin weave' is used to imply special structural traits that are characteristic of Gobelin tapestries, it would be less confusing to simply say *tapestry weave*.

Slit tapestry · Kilim tapestry · Kilim

The use of the term *kilim* as a synonym for *slit tapestry* (or as a synonym for *slit*) seems to have little justification. *Kilim* (also written kelim, khilim, gilim, chelim, and so on) is a term which is widely used to refer quite precisely to *tapestry-woven rugs* as distinguished from rugs of different construction, especially 'knotted pile' rugs and the flat-woven (but not plain-weave) rugs known as *Soumak*. Presumably *tapestry weave* was utilized for rugs long before the development of the technique of securing yarns round warp threads in such a way that loops could be left (and cut, if desired) to form a pile (see pp. 221 ff.). In many areas of Persia, Turkey, the Caucasus, and other countries, the production of tapestry-woven rugs continued concurrently with the development of the knotted-pile rugs for which the areas became famous.

Although the term *kilim* (like *Palas* and *Karamani*) seems to refer primarily to tapestry-woven rugs, there may be justification for using it to designate any *weft-faced plain-weave* rug since, in the development of *kilim* rugs, the use of unpatterned *weft-faced plain weave*, and later of unbroken transverse bands of weft color, apparently preceded *tapestry-weave* patterning. But it is hard to understand why the word *kilim* was ever employed to designate *slit* tapestry specifically. It is true that *kilims*, like other tapestry-woven fabrics, are often woven without any interlocking or dovetailing of wefts and sometimes with slits used as a decorative device. But there seems to be no more basis for associating slits with *kilim* weaving than with any other tapestry weaving. In fact the Chinese term *k'o-ssŭ* refers to fabrics that are more consistently *slit tapestry* than *kilims* are. But it is understandable that once the term *kilim* was used to designate *slit tapestry*, its meaning could become more distorted until it came to be applied to the slit itself and eventually used in such redundant and contradictory expressions as *kilim tapestry* (in which *kilim* presumably means *slit*) and *kilim slit* (in which *kilim* presumably means *tapestry-woven*). Inasmuch as *kilim*, when not used in the accepted sense of a tapestry-woven rug, is usually defined as 'slit tapestry,' it seems more direct and practical to use the term *slit tapestry* and avoid the need for special definition.

In general, if the term *tapestry weave* is not qualified, it will be construed as a reference to what is structurally *slit tapestry* (i.e. tapestry without 'joins'). The term *slit tapestry* is often used specifically to imply visible slits, planned utilization of slits, or long slits that have been sewed up. The word *unlocked* has been used to describe the slit-tapestry structure when the slits are too small to be visually significant, although 'un-joined' might be better for the purpose since it could not be construed as involving a distinction between *interlocking* and *dovetailing*. However, since the weave structure is not affected by the length of the slit, there should be no need for a structural term that makes a distinction based solely on that characteristic. All *slit tapestry*, of course, could be described as 'un-joined.'

Reinforced tapestry · Reinforced kilim

The term *reinforced tapestry* should be used with discretion (*reinforced kilim*, preferably not at all). It is true that in what is otherwise a regular *slit-tapestry weave* there may be subordinate wefts (sometimes called 'structural wefts') which are hidden by the tapestry wefts and serve both to reinforce the fabric and to counteract the structural weakness of slits, without recourse to *dovetailing* or *interlocking*. If hidden subordinate wefts occur in a fabric in which the tapestry wefts are dovetailed or interlocked, it must be presumed that they were used solely to strengthen the fabric – unless they also function outside the areas of tapestry weaving. When hidden wefts are used only at intervals and solely for reinforcement, the term *reinforced tapestry* may have some descriptive validity. But so-called 'reinforcing wefts' often alternate with 'tapestry wefts,' and if their interlacing with the warp in itself produces a

complete weave structure, the 'tapestry wefts' fulfill the function of a *supplementary* decorative set (see pp. 140 and 145). This is obvious in the instances already referred to in which the 'subordinate' wefts extend beyond the 'tapestry' wefts and interlace with the warp in areas outside the tapestry areas. But regardless of spacing, extent, or terminology, 'reinforcing wefts' have a different function from that of 'tapestry wefts' and constitute an additional *set.* It may be maintained that *tapestry weave* is the main weave of a fabric that has a *supplementary set* of reinforcing wefts; or the structure may be construed as having a concealed ground weave with *supplementary wefts* worked in *tapestry weave.* Whatever the interpretation, such a structure has two sets of wefts, one of which is a *supplementary set.* The weave, therefore, is not a *simple* (one warp set, one weft set) *weave*, whereas true *tapestry weave* is.

*Warp-interlock tapestry • Interlocked cloth • 'Patchwork' • Warp and weft interlocking**

The unusual fabric structure found in considerable variety in the fabrics of ancient Peru, in which discontinuous warps as well as discontinuous wefts are used to create solid-color pattern areas of balanced (and sometimes quite open) *plain weave*, presents a problem in nomenclature. Specific fabrics have been described in considerable detail and the words used to describe the unusual characteristics of the structure have suggested designations for it. One of the most useful of them seems to be the term *warp-interlock tapestry; warp-interlock* implying the distinguishing discontinuous-warp trait, and *tapestry*, the *plain weave*, discontinuous wefts, and solid-color areas typical of *tapestry weave* (although the fabric is not *weft-faced*, as is typical of *tapestry weave*, and neither the nature of the 'join' between wefts nor the lack of any is indicated by the term).

In another term, *interlocked cloth*, the word *cloth* may serve to suggest a balanced *plain weave*, and the word *interlocked*, the joining of discontinous elements (and perhaps patterning by implication) but the term gives no real hint of the unusual warp structure. The term *two-way interlocked cloth* would be more definitive particularly when both warps and wefts are interlocked if it were not for the already established use of the expression 'two-way interlock' to designate 'double interlocking' of wefts in regular *interlocked tapestry* (see p. 81).*

Another term, *patchwork*, also has other well-established fabric applications (see p. 252) and is not definitive in this special context unless qualified. Nevertheless, it is used (sometimes partially identified by the word *Peruvian*) for those tie-dyed fabrics which, having been woven in series of squares with unjoined discontinuous wefts on discontinuous warps 'dovetailed' round 'scaffold' wefts, have been taken apart (after dyeing) by withdrawing the 'scaffold' wefts and later rejoined (with the squares rearranged) by replacing the withdrawn wefts. The slits between discontinuous-weft areas are sewn up.

PART TWO

Classification of the Structures of Fabrics

I Felted Fibers

II Interworked Elements

A. Single Element

B. Two Single Elements

C. One Set of Elements

D. Two or More Sets of Elements

1. Interlacing warps and wefts

a. Simple weaves

1). Plain weave

2). Float weaves

(*see below*)

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2). FLOAT WEAVES

a.) Twill weaves

(1). Even twill

Variations:

Horizontal herringbone
Broken twill
Vertical herringbone
Diamond twill

(2). Uneven twill

Variant use: *'turned twill,' 'twill damask'*

Variations:

Horizontal herringbone
Broken twill
Vertical herringbone
Diamond twill

Note on elaborations of twill variation

Combined twills
'Figured twills'

Variant use of simple twill

Twill tapestry

b.) Satin weaves

Variation: *irregular satin weave*
Variant use: *satin damask*

c.) Float weaves derived from plain weave

(1). Alternating float weave

Types of variation:

Float span
Float orientation

Variant uses:

Openwork
Extended patterning

Note on similar effects in different weaves

NOTES ON THE USE OF TERMS

Float • Skip • Overshot • Flushing
Pattern-weave • Figure-weave • Fancy weave
Fancy cloth • Huckaback • 'Bronson' • Mock leno
Terminology of twill weaves
Even • Equal • Balanced • Regular
Uneven • Unequal • Irregular
Simple • Plain • Regular
Compound • Combined • Irregular • Broken • Fancy
Reversed twill • Herringbone • Wave • Zigzag • Chevron
Diamond • Lozenge • Birdseye • Goose-eye • Crystal • Diaper
Reversed • 'Turned' • 'Counterchanged' • Damask
Reversed • 'Reversible' • Reciprocal reversal
Damask • Twill damask • Damassé • 'Han damask'
Diaper • Diaper pattern • Diaper weave
Satin • Sateen • Satinet

2. FLOAT WEAVES

In *simple interlacing* (of one set of wefts with one set of warps) any deviation from the consistent alternation which characterizes *plain weave* necessarily produces warp and weft *floats* (for definition of *float*, see p. 75). Random floats or 'skips' which are obviously mistakes do not affect the nature of the weave; but when floats are used in organized arrangements the weave is a *float weave*. Innumerable pattern and texture variations can be obtained by varying the span of individual floats and the order in which they are arranged. As already noted (p. 75) floats on one face of a *simple interlaced* fabric structure are associated with correlated floats of the opposite set of elements on the opposite face of the fabric.

Certain large groups of *float weaves* are distinguished by differences in the basic system of the organization of floats. *Twill weaves*, for example, are characterized by progressive successions of floats in diagonal alignment; *satin weaves*, by similarly ordered but intermittent progression of floats and suppression of the appearance of diagonals. In both, the basic orders of interlacing are single and unmixed (in a *plain 3/1 twill*, for example, the order of both warp- and weft-interlacing is 3/1 throughout, in a *regular 7/1 satin weave*, 7/1 throughout).

In addition to these two recognized and well-defined groups, there are diverse *simple float-weave* structures marked not by progression but by alternation in the alignment of floats or by some rectangular, rather than diagonal, arrangement.

A. TWILL WEAVES

Twill weaves are *float weaves* characterized by a diagonal alignment of floats for which a minimum of three warp groupings is essential (four, for warp and weft floats of equal span). Adjacent wefts never float over or under the same group of warps, and for each successive passage of the weft the warp grouping is stepped one warp beyond the previous grouping. If the shift is always to the right or always to the left, *continuous diagonals* will be formed on both faces of the fabric. The direction of diagonals on one face is always the reverse of that on the opposite face.

Although different viewpoints and purposes naturally lead to different systems of classification, the primary structural differences between *twill weaves* pertain to two basic factors: the numerical span of the floats and the direction of the diagonals. The numerical designation of a twill gives its basic *float-span ratio* – for example, 2/1, 3/1, 2/2.

In all *simple-weave twills* there are both warp and weft floats. If the over-and-under order of interlacing is *even* (i.e. if elements pass over the same number that they pass under) there will be warp and weft floats of equal span on both faces of the fabric, and the twill is said to be an *even twill*. If the order of interlacing is *uneven*, all the warp floats may be on one face of the fabric and all the weft floats on the other (e.g. in *2/1 twill*, if the weft goes over-2-under-1 warp on one face, the warp will go over-2-under-1 weft on the opposite face); or there may be unequal-length warp and weft floats on both faces but with the proportions interchanged (e.g. in *3/2 twill*, the weft going over-3-under-2 warps on one face, the warp over-3-under-2 wefts on the other). In either case the twill is *uneven*.

NOTE: that although *even twills* are sometimes called 'balanced twills,' all twills, even or uneven, can be 'balanced' in the sense of having equal warp and weft 'counts,' just as all can have any degree of preponderance of warp or weft.

If there are no changes of direction or breaks in the diagonal alignment of floats (e.g. fig. 115), the diagonals are said to be *continuous*, and the twill is variously referred to as 'plain,' 'regular,' 'simple,' 'biased,' 'diagonal' (pp. 128 f.), although it is usually assumed that the term *twill* connotes continuous diagonals unless modified by another term specifying the kind of broken continuity. The continuity of the diagonals can be broken simply by changing their direction at intervals to create patterns of diagonals like zigzags, chevrons, and diamonds, or by omitting steps in the progression in order to break up the diagonal effect and create unpatterned texture variations.

1. EVEN TWILL

Even twills are those in which elements of each set pass over and under equal numbers of the opposite set. This makes the numerical order of both warp- and weft-interlacing the same on the two faces of the fabric and the two faces *identical*, although the direction of the diagonals is reversed. Construction of

an *even twill* requires a minimum of four different warp groupings, and this minimum (designated 2/2 since the interlacing is over-2-under-2) is used here to typify all *even twills* (see figs. 115 ff.).

FIG. 115 'Plain' *2/2 twill*. The diagonals are *continuous*, their direction reversed on the opposite face.

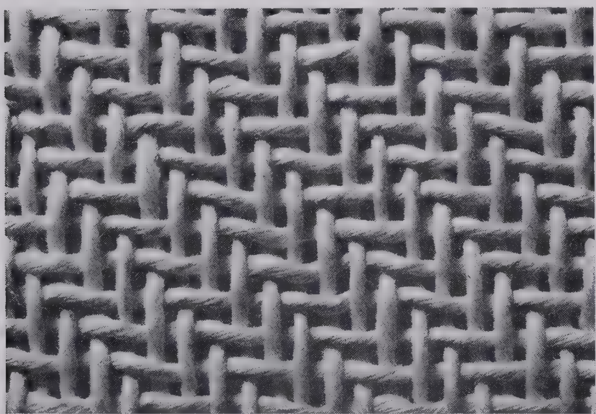


FIG. 116 Diagrammatic construction of fig. 115.

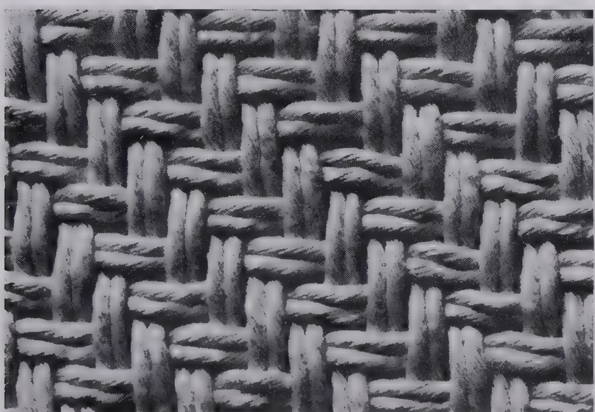


FIG. 117 A *2/2 twill* with *paired warps* and *wefts*.

NOTE: that the use of two or more elements as warp or weft units does not affect the nature or the numerical designation of a twill structure. In a *2/2 twill* with *paired warp* and *weft* elements, for example, the pairs are used as units, each weft unit passing over-2-under-2 warp units and vice versa (fig. 117).

Floats may differ in actual length even when their numerical span is the same. For example, both the *warp-faced 2/2 twill* in figure 118 and the *weft-faced 2/2 twill* in figure 119 are *even twills*, and the warp and weft floats have the same numerical span in both, although in one, only the warp floats appear as floats, and in the other, only the weft. The interlacing order and the numerical span of floats in plain *2/2 twill* is always the same (see fig. 116).

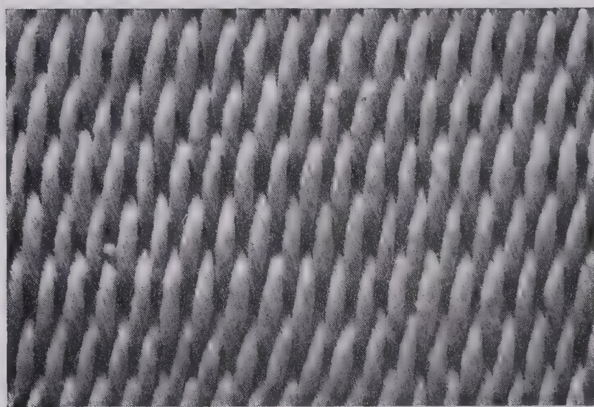


FIG. 118 *Warp-faced 2/2 twill.*

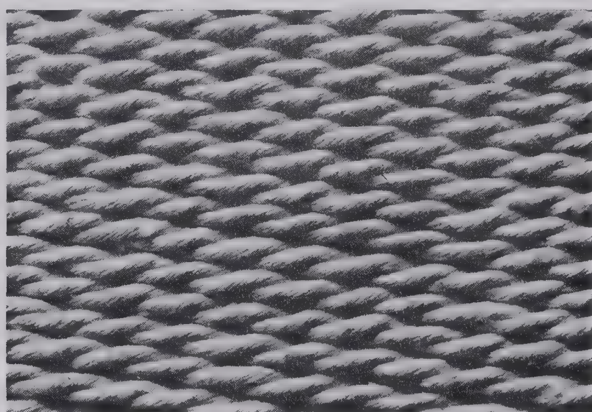


FIG. 119 *Weft-faced 2/2 twill.*

It will be noted that a marked predominance of one set of elements tends to reduce the diagonal effect. This is true of all twill structures, even or uneven, with or without *continuous diagonals*. One practical device for avoiding such loss of pattern in either a *warp-* or a *weft-faced twill* is the use of a

succession of colors in the predominant element. With alternate colors in a 3-unit twill (2/1) or a succession of three colors in a 4-unit twill (2/2 or 3/1) the floats of each color will fall in diagonal series (fig. 120). As can be seen in figure 121, when the diagonal formed by the float succession (the structural diagonal) is up to the right, the diagonal formed by the color succession will be up to the left. The direction of both diagonals is reversed on the opposite face.*

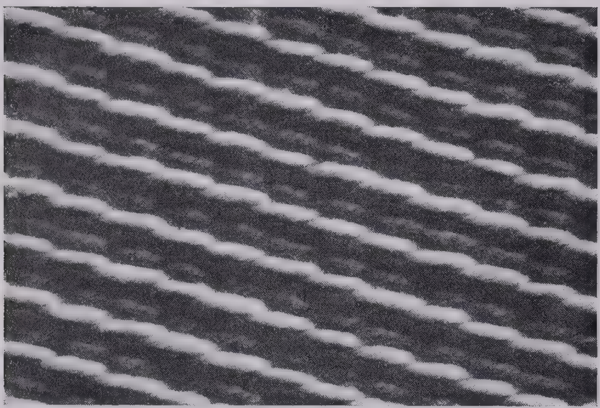


FIG. 120 Succession of three weft colors in *2/2 weft-faced twill.*

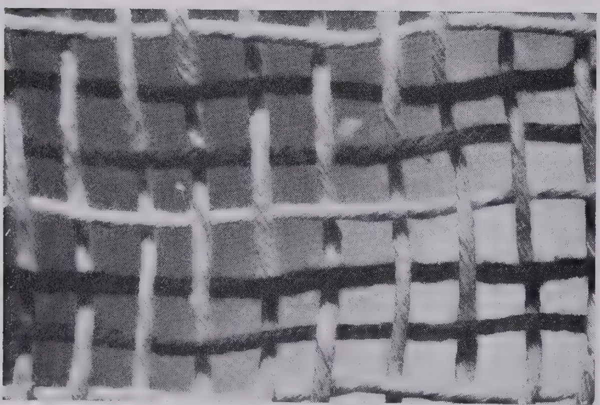


FIG. 121 Diagrammatic construction of fig. 120, showing the relationship of the up-to-the-left color diagonal to the up-to-the-right structural diagonal.

NOTE: that when all the elements of one type (warp or weft) function as components of the same twill succession, they constitute a single *set of elements* regardless of color variation. However, if wefts (for example) of one color are used in one twill successsion while others of a different color are weaving a distinct but simultaneous twill on the same warps, each color functions as a separate *set*; the color diagonals are identical with the twill diagonals; and the twill structure is *compound* (see pp. 160 f.).

VARIATIONS OF EVEN TWILL

In *plain twill* the diagonal alignment of floats is consistent and continuous; and the numerically designated order of interlacing is maintained by both warp and weft throughout. However, breaks in the continuity and reversals of the direction of the diagonals can be arranged in innumerable different ways to produce variations of structure and pattern in which the interlacing order of either or both sets of elements is almost invariably altered to some extent. The variations are usually described in terms of the associated patterning (e.g. *zigzag, wave, herringbone, chevron, diamond, lozenge*) but the application of the terms is neither specific nor uniform (see pp. 130 ff.).

Zigzags and herringbone patterning can be produced by repeatedly reversing the diagonals at intervals either along (fig. 122) or across (fig. 125) the fabric, diamond patterning by a combination of the two (fig. 131, p. 97). The change of direction is *symmetrical* when the opposed diagonals meet at the line of change (as in fig. 122), *asymmetrical* or *staggered* when they alternate along the line of change (fig. 123). Twill weaves characterized by *symmetrical* changes of direction are sometimes described as 'pointed twills,' sometimes as having 'accurate' or 'exact' meetings of diagonals, although it is often assumed that, unless otherwise stated, the change of direction is *symmetrical.* A *staggered* line of change is sometimes indicated by the term *broken,* sometimes described as 'inaccurate' or 'inexact'; occasionally, it is implied in a specific weave name like 'dornik' or 'crystal twill' or the twill may be described as 'non-pointed' (see pp. 131 f.).

HORIZONTAL HERRINGBONE · If the direction of the diagonal is reversed along the horizontal axis, that is, if transverse bands of up-to-the-left twill alternate with bands of up-to-the-right twill (fig. 122), the axis or 'spine' of the herringbone patterning will be horizontal, and the weave can be described as *horizontal herringbone.* It is also referred to as *reversed twill* (since the diagonals are reversed from time to time as the weaving progresses), as *waved twill, weft-wise chevron,* and so on (see pp. 130 f.).

Reversing the diagonals as the weaving progresses does not alter the order of weft-interlacing, but does entail variation in the order of warp-interlacing along the lines of change. In *2/2 horizontal herringbone,*

wefts consistently pass over-2-under-2 warps; but where the diagonals are reversed, if the reversal is *symmetrical*, alternate warps will pass over and under three wefts, the intervening warps over and under only one (figs. 122 and 126).

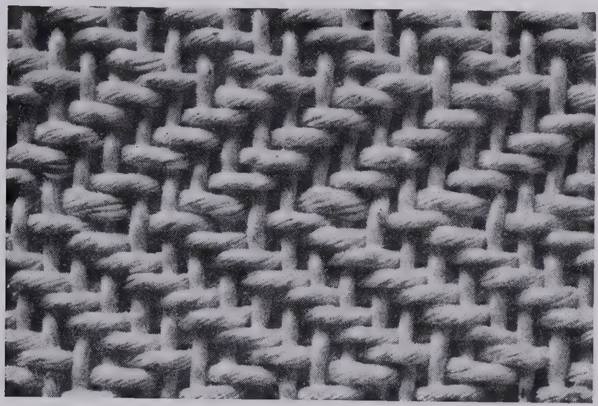


FIG. 122 *Symmetrical* (or 'pointed') *2/2 horizontal herringbone.*

If the diagonals are *staggered*, that is, alternated, along the line of change, the break between areas of opposite twills is visually emphasized, although there is less variation in warp-float span than when the reversal is *symmetrical.* In *staggered 2/2 horizontal herringbone* (fig. 123) the float span of half the warps is unaffected by the reversal of the diagonals, and alternate warps pass over-1-under-1 weft where the direction changes. All such variations of float span are *identical* on the two faces of *even twills.*

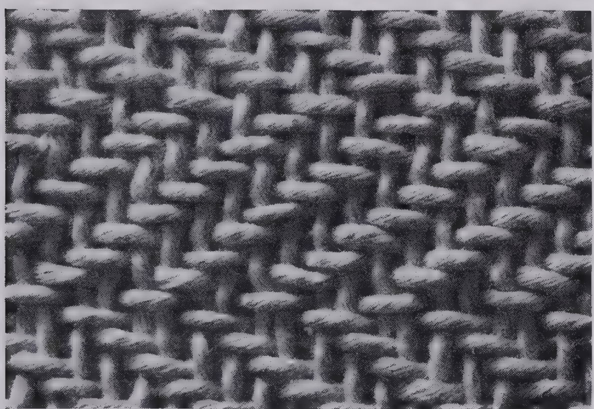


FIG. 123 *Staggered* (or 'non-pointed') *2/2 horizontal herringbone.*

BROKEN TWILL If the direction of the diagonal float-alignment is never maintained for more than two weft passages, and the changes are *staggered* (fig. 124), no diagonal is developed. It is this type of 'broken up' twill, actually a succession of *staggered* reversals, that is usually meant by the term *broken twill* (see p. 129).

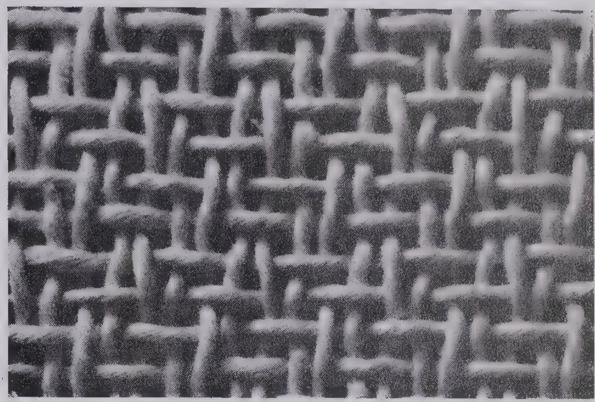


FIG. 124 Diagrammatic construction showing a succession of *staggered* reversals in *2/2 twill,* usually called *broken twill.*

VERTICAL HERRINGBONE If there are changes in the direction of the twill diagonals at intervals across the fabric (fig. 125), the areas of opposed diagonals and the lines of change will extend longitudinally; and the axis of the *herringbone* patterning will be *vertical.* This is the structure (and patterning) that is usually meant when the term *herringbone twill* is used without qualification. The terms *chevron, warpwise chevron, wave, zigzag, lateral zigzag,* and many others, are also used (see pp. 130 f.).

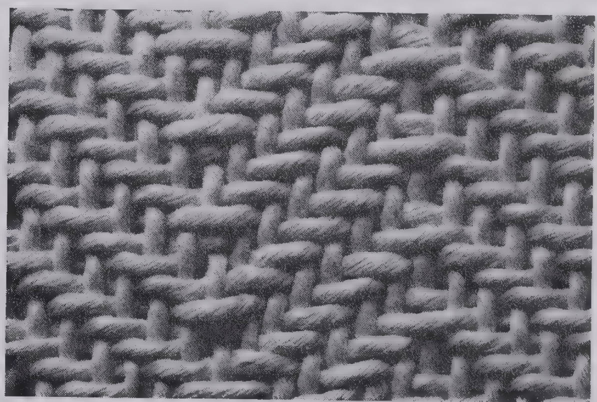


FIG. 125 *Symmetrical* (or 'pointed') *2/2 vertical herringbone.*

The structures of *vertical* and *horizontal herringbone twills* are exact counterparts, except that the order of interlacing is interchanged between warp and weft and the direction of the axis or 'spine' of the herringbone pattern correspondingly altered. In terms of construction, however, the interchange of warp and weft is more significant. *Plain* (continuous

diagonal) *twill* can be converted into *horizontal herringbone* at any point in the weaving process; neither the intervals between reversals of diagonals nor the type of reversal need be determined before weaving, and both can be varied during the process. But for *vertical herringbone* (on a heddled loom), both the type and the spacing of the reversals must be planned, and the plan incorporated into the heddling arrangements, prior to weaving; neither can be changed without re-ordering the heddling arrangement.

NOTE: that when 'heddling arrangements' are made by looping cords alternately round selected warps and 'heddle rods,' they can be made after the warp is in place on the loom and changed even after the fabric is partially woven. Although admittedly laborious and time-consuming, it is nevertheless entirely possible and not uncommon for the heddling system to be completely rearranged (sometimes more than once) in the course of weaving a fabric.

Since a marked predominance of either warp or weft tends to lessen the prominence of twill diagonals (see pp. 93 f.), the contrast between areas of opposed diagonals in herringbone twills is naturally correspondingly reduced. At the same time, the variations of interlacing order which occur where the diagonals reverse may accentuate the line of change. If a *horizontal herringbone* – in which it is the warp-interlacing order that varies (fig. 122) – is woven *warp-faced*, the lengthened float spans of alternate warps will mark *symmetrical* lines of change with transverse 'wales' (fig. 126) which are *identical* on the two faces of the fabric. (If the lines of change are *staggered* there are no lengthened floats, hence no discernible 'wales.')

In *vertical herringbone* the order of weft interlacing varies precisely as does the order of warp interlacing in *horizontal herringbone*. Thus when symmetrical vertical herringbone is *weft-faced* (fig. 127), the structure is analogous to symmetrical horizontal herringbone when *warp-faced* (fig. 126) – the lengthened float spans of alternate wefts marking the reversal of diagonals with longitudinal 'wales.'

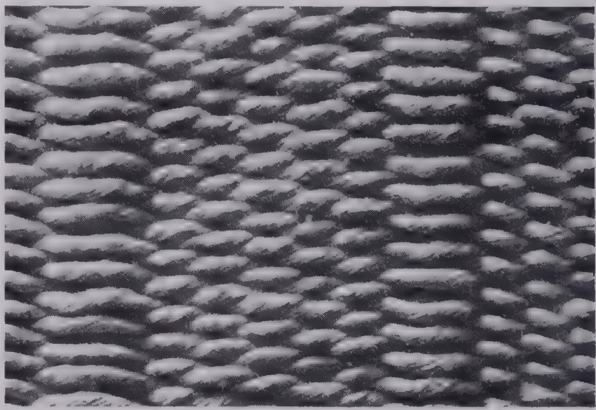


FIG. 127 *Symmetrical 2/2 vertical herringbone – weft-faced.*

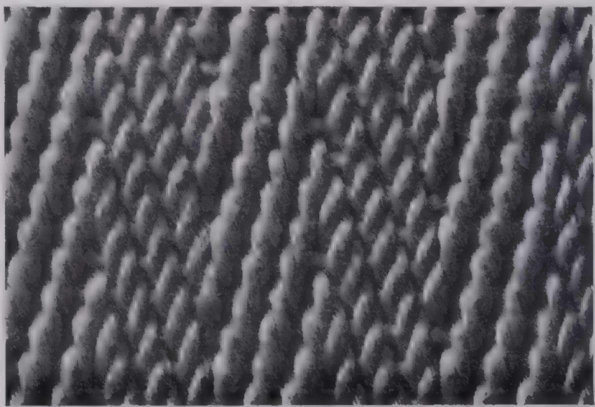


FIG. 128 *Symmetrical 2/2 vertical herringbone – predominant warp.*

NOTE: that if it is the regularly-interlacing set of elements that predominates (i.e. *warp* in vertical herringbone, *weft* in horizontal), variations of interlacing order coincident to reversals of diagonals tend to be hidden. When the regularly-interlacing set predominates but does not entirely conceal the other set (fig. 128), although there is little visible evidence of the varied float spans, the contrast between the areas of opposite diagonals is apparent. But when the regularly-interlacing set completely conceals the other set (fig. 129), neither the con-

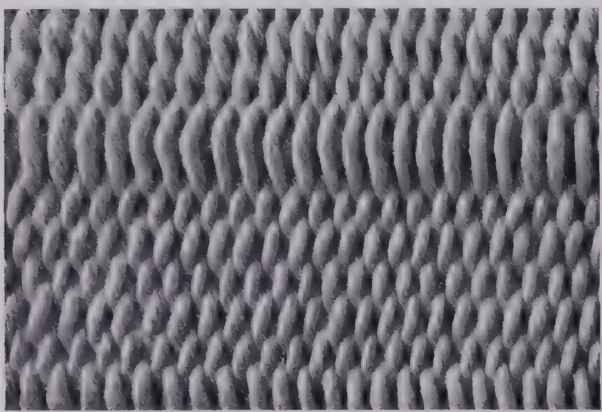


FIG. 126 *Symmetrical 2/2 horizontal herringbone – warp-faced.*

trast between texture areas nor the variation of interlacing order will be more than barely perceptible, and some color-succession device is likely to be employed to mark or create diagonals.

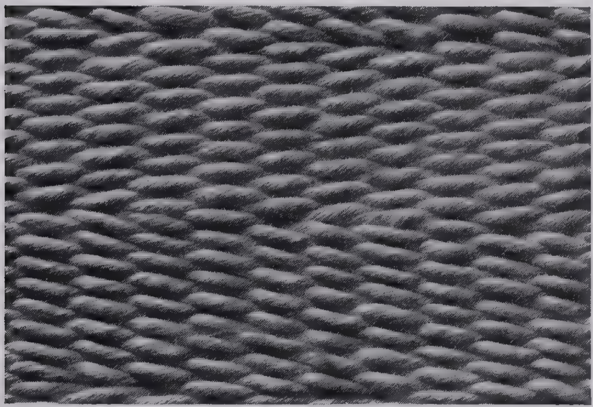


FIG. 129 *Symmetrical 2/2 horizontal herringbone — weft-faced.*

NOTE: that the term *zigzag twill* is used, with varying degrees of generality, to designate: any twill having reversed diagonals; any twill with reversals in one direction only; such a twill if the 'zigzags' are horizontal; or only if the 'zigzags' are vertical. So used, it is usually accompanied by some explanatory word or phrase, as in 'lateral zigzag' or 'zigzag on a vertical axis'; but occasionally it also serves to identify those variations of the herringbone type of float alignment in which the intervals between changes of direction are alternately long and short (fig. 130), a type also described as 'irregular herringbone,' 'uneven reversed twill,' and so on (see also p. 130).

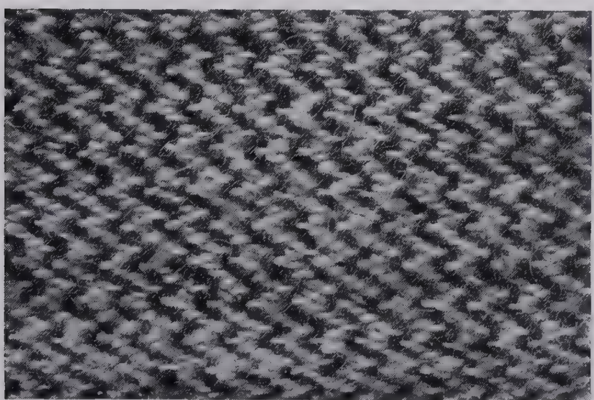


FIG. 130 A 2/2 'zigzag' or 'irregular herringbone' *twill* — the 'zigzag' is vertical, the 'axis' and the 'herringbone' are horizontal. (Detail of a fabric woven of single wool yarns, natural brown and white.)

DIAMOND TWILL: If the direction of the twill diagonal is reversed at regular intervals both along the fabric (as in *horizontal herringbone*) and across it (as in *vertical herringbone*), symmetrical reversals can be co-ordinated so that the diagonals converge in concentric diamonds producing the structures (e.g. figs. 131 and 132) known as *diamond*, or *lozenge, twills* (see pp. 131 f. for use of terms).

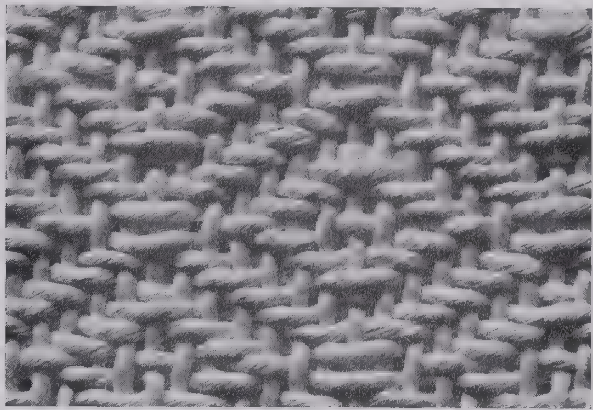


FIG. 131 *Symmetrical 2/2 diamond twill.*

A *diamond twill* combines the structural characteristics of the *horizontal* and *vertical herringbones* of which it is composed. Its numerical designation is that of the basic interlacing order; but this occurs only in the diagonals, since the two-fold reversals alter the order of both warp and weft interlacing with each change of direction. If the basic interlacing order is *even* (and therefore *identical* on the two faces of the fabric), the variations too will be identical, except in their orientation to the *diamond* pattern (compare figs. 131 and 132).

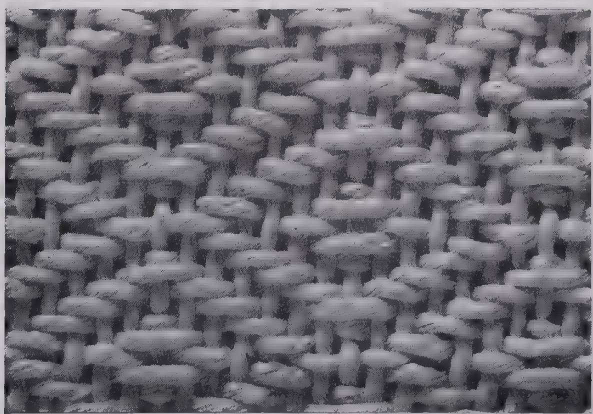


FIG. 132 Opposite face of fig. 131, showing a characteristic difference in the relationship of the varied interlacing orders to the diamond.

Variations of *diamond twill* can be correlated with those of the component *herringbone twills*; and the effect of predominance of either warp or weft in *diamond twill* is a combination of the effects of comparable predominance in *horizontal* and in *vertical herringbone*. Compare, for example, the effect of warp predominance on a *symmetrical 2/2 diamond twill* (fig. 133) with its effect on each of the two component *herringbone twills* (figs. 126 and 128, p. 96), and note that an analogous composite of figures 127 and 129 would be found in a *weft-faced symmetrical 2/2 diamond twill*.

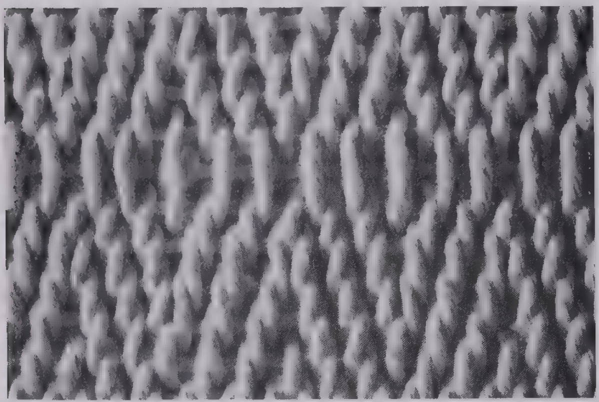


FIG. 133 *Symmetrical 2/2 diamond twill — predominant warp.*

Symmetrically reversed diagonals are essential to the formation of true 'diamond' shapes. When the diagonals are *staggered* along the lines of reversal (fig. 134), the blocks of opposed diagonals (which alternate in both directions) suggest diamond shapes, but their asymmetrical centers lack the 'birdseye' appearance found in *symmetrical diamond twills* (e.g. figs. 131, 132, and 136).

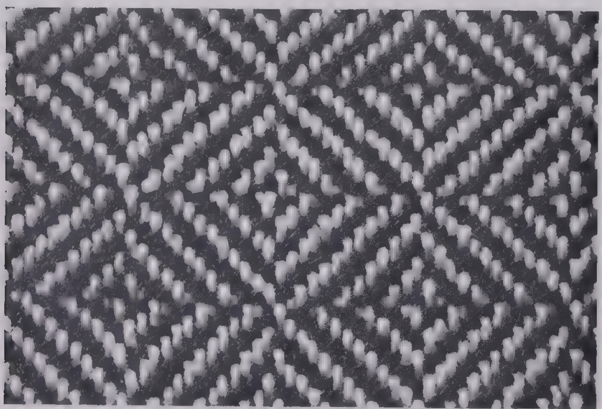


FIG. 134 A *2/2 diamond twill* with all reversals *staggered* (sometimes called 'crystal twill').

It seems customary, however, to use the term *diamond* (or *lozenge*) for any twill in which both horizontal and vertical reversals of diagonals are evenly spaced and correlated, whether or not completely symmetrical diamond figures are created. The terms *birdseye* and *goose-eye*, although often used in the same way (i.e. as general synonyms for *diamond twill*), are also used to specify the accurately centered *symmetrical diamond twills* whose appearance they suggest (e.g. fig. 136). The term *diaper* sometimes refers to small allover diamond-twill patterning, but it has many other meanings as well, some general, some specific (see pp. 131 and 136). The term *crystal twill* (p. 131) seems to be the only one used to specify a *diamond twill* with *staggered* reversals of diagonals (e.g. fig. 134).

NOTE: that the use of contrasting colors in warp and weft elements emphasizes the patterning of twills in which both warp and weft are visible (figs. 135 and 136).

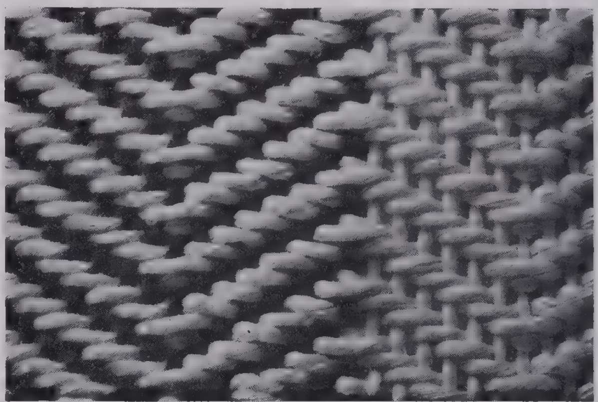


FIG. 135 Effect of varying warp color in a *symmetrical 2/2 vertical herringbone*.

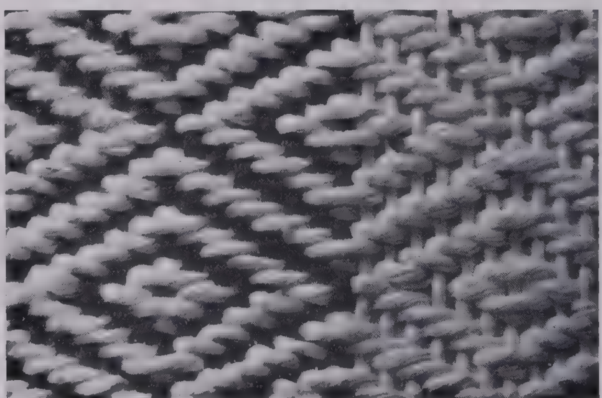


FIG. 136 Effect of varying warp color in a *symmetrical 2/2 diamond* (or *birdseye*) *twill*.

2. UNEVEN TWILL

The basic interlacing order of an *uneven twill weave* is such that no element passes over the same number of elements it passes under; thus the two faces are always structurally *dissimilar*. No *twill weave* can be constructed with fewer than three different warp groupings, and one constructed with only three is necessarily 2/1, that is, an *uneven twill*. With four groupings, either *even* (2/2) or *uneven* (3/1) *twill* is possible; with five, there is a choice of *uneven twills* (4/1 or 3/2). The number of possible twill-interlacing orders increases with additional warp groupings.

On either face of an *uneven twill*, the interlacing order of the warp is the converse of the weft order. For example, on one face of a *2/1 twill*, each weft passes over one warp and under two, the warp over two wefts and under one (figs. 137 and 138). Since the only floats on this face are *warp floats*, it can be designated the *warp-float face*.

On the opposite or *weft-float face*, warp and weft are interchanged in interlacing order, and the only floats are *weft floats* (figs. 139 and 140).

NOTE: that it is characteristic of all *simple uneven twills* that the floats (or the numerically greater float spans) of warp are on one face of the fabric and those of the weft on the other. Specific designation of one face or the other is frequently necessary but usually confusing. The term *warp twill*, for example (although sometimes used simply to indicate that a twill – any twill – is *warp-faced*) is often used in reference to the *warp-float face* of an *uneven twill*, not to designate it but to establish the fact that it is either known or assumed to be the 'right side' of the fabric and is the structure being described. (Presumably the *weft-float face* of the structure would be identified simply as the 'back' or 'wrong side' of a *warp twill*.) Sometimes one face of an *uneven*

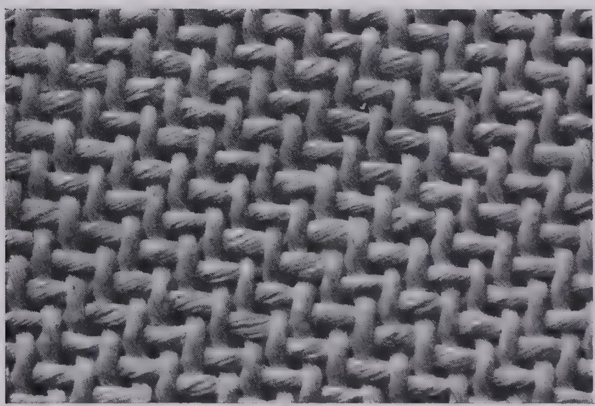


FIG. 137 The *warp-float face* of a *2/1 twill* (opposite face of fig. 139).

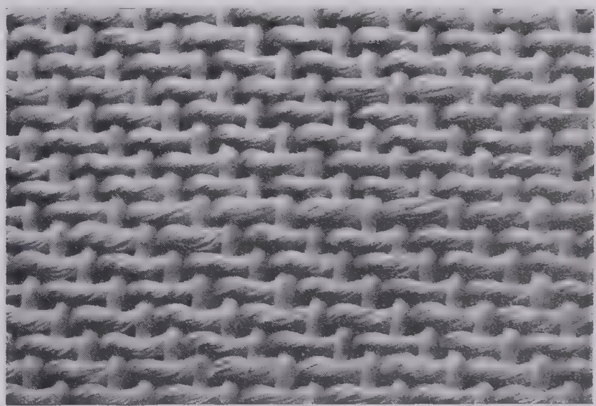


FIG. 139 The *weft-float face* of a *2/1 twill* (opposite face of fig. 137).

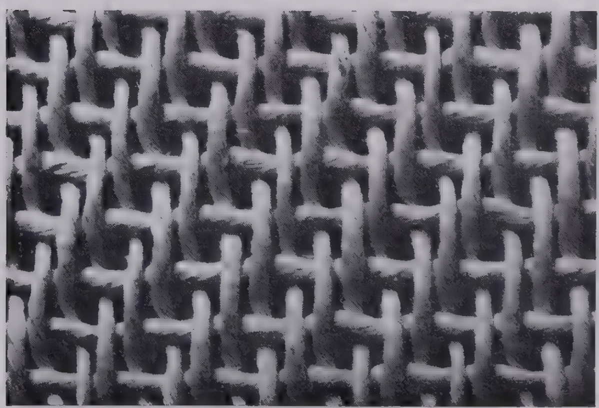


FIG. 138 The *warp-float face* of a *2/1 twill* – diagrammatic construction of figs. 137 and 141 (opposite face of fig. 140).

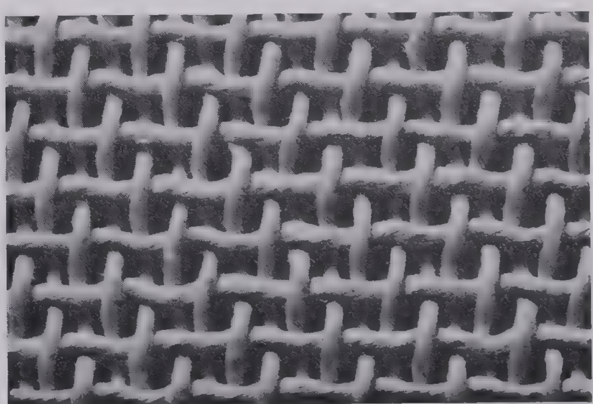


FIG. 140 The *weft-float face* of a *2/1 twill* – diagrammatic construction of figs. 139 and 142 (opposite face of fig. 138).

twill is referred to as the 'warp face,' the other as the 'weft face,' but this is confusing if the twill happens to be *warp-* or *weft-faced* by reason of the preponderance of one set of elements; and the terms *warp-effect* and *weft-* (or *filling-*) *effect* seem to be used more to specify which face of a weave serves as the 'right side' of a fabric than to distinguish between the two faces. In general, it seems more practicable to differentiate between the *warp-float* and the *weft-float faces*, although it must be borne in mind that it is to the actual order of interlacing that these terms refer and in a *warp-faced twill*, for example, the wefts may be barely visible on the *weft-float face* (see fig. 142). The two faces can, of course, be differentiated in the numerical designation of the twill if a horizontal line is used to symbolize the weft. The formula $\frac{\quad 2}{1 \quad}$, for example, would refer to the face of a *2/1 twill* on which the weft passes over one warp and under two (figs. 137, 138, 141), $\frac{\quad 1}{2 \quad}$, the face on which it passes over two and under one (figs. 139, 140, 142).

Although *2/1 twill* is structurally typical of *uneven twill* weaves, the increased contrast between float span and single 'tie' in *3/1 twill* gives increased emphasis to the characteristic dominance of warp on one face and weft on the other (figs. 143, 144, 145).

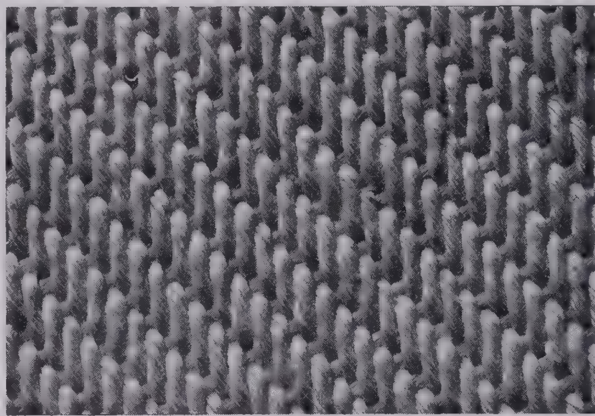


FIG. 143 The *warp-float face* of a *3/1 twill.*

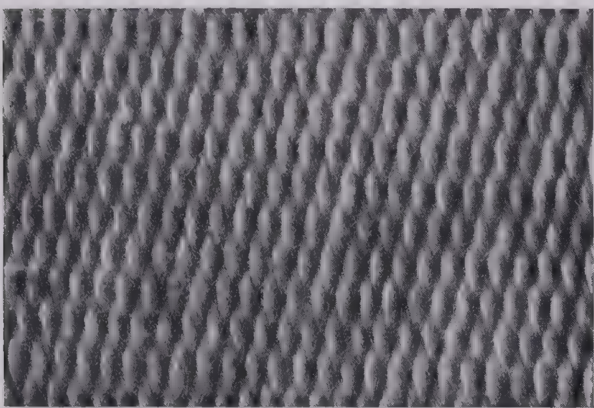


FIG. 141 The *warp-float face* of a *warp-faced 2/1 twill.*

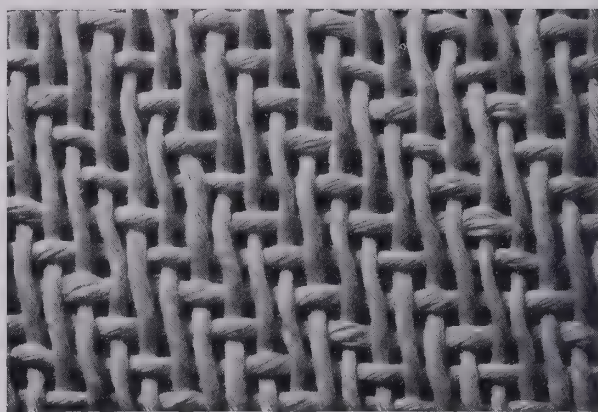


FIG. 144 Diagrammatic construction of fig. 143.

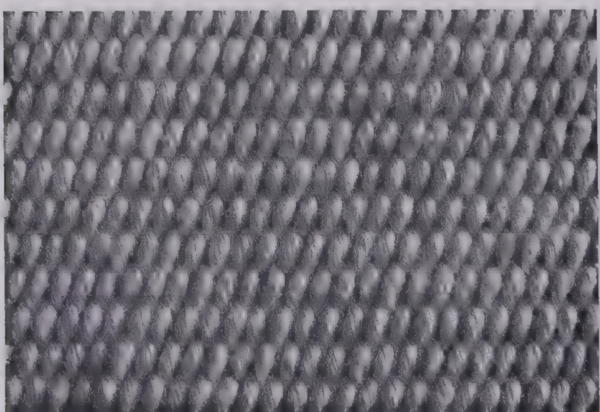


FIG. 142 The *weft-float face* of a *warp-faced 2/1 twill* (opposite face of fig. 141).

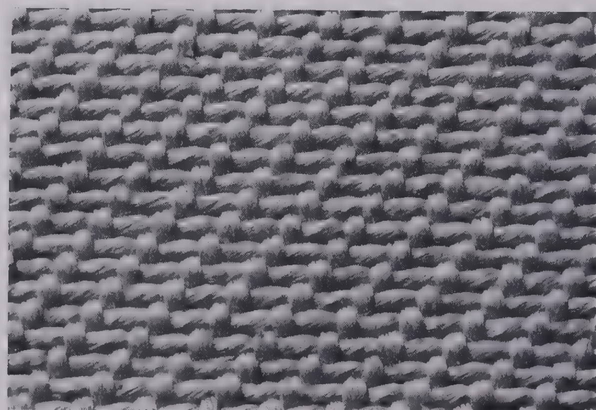


FIG. 145 The *weft-float face* of a *3/1 twill* (opposite face of fig. 143).

VARIANT USE: *'Turned twill,' 'twill damask'*

The contrast in appearance between the two faces of *uneven twill* is exploited when the two aspects are used in alternate areas on the same face of the fabric. This is sometimes described as 'turning,' 'reversing,' or 'counterchanging' the twill (see p. 132). Areas are identical on the reverse of the fabric, but the relative positions of the *warp-* and *weft-float faces* are interchanged. (For comments on the use of the word *reversible* for pattern duplication with textures or colors reversed, see p. 133.) There is sufficient contrast between the appearance produced by the dominant vertical elements of the *warp-float face* and that produced by the dominant horizontal ones of the *weft-float face* (figs. 146 and 147) to make patterning effective without recourse to color or texture variation.

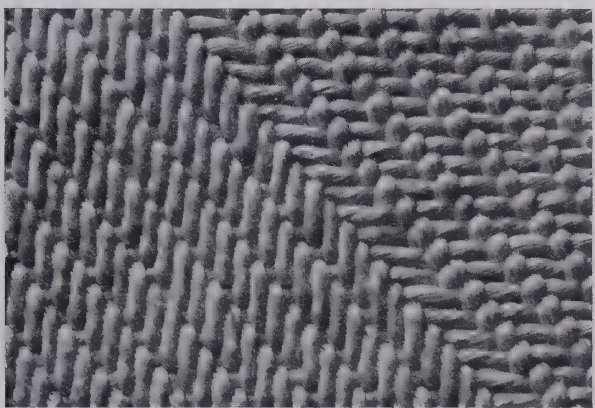


FIG. 146 Use of both the *warp-float face* and the *weft-float face* of a *3/1 twill* on the same face of a fabric.

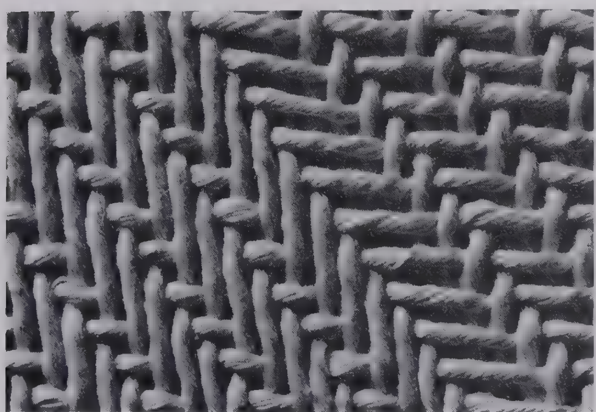


FIG. 147 Diagrammatic construction of fig. 146.

With warp and weft elements that differ in color or texture, the contrast between areas of dominant warp and areas of dominant weft will be increased in proportion to the amount of contrast between the two sets (compare figs. 148 and 149 with figs. 146 and 147).

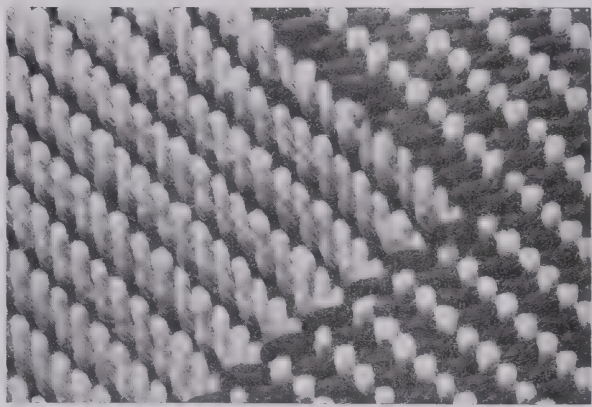


FIG. 148 Showing the increased contrast between the *warp-* and *weft-float faces* of a *3/1 twill* which results from the use of contrasting colors for warp and weft.

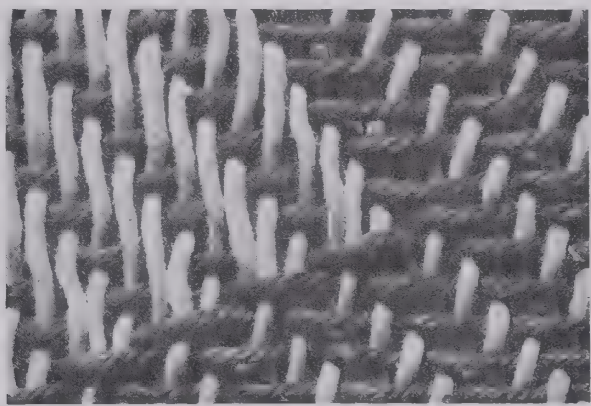


FIG. 149 Diagrammatic construction of fig. 148.

The visual contrast between the two aspects is used for many kinds of patterning, from simple stripes to realistic figuring. The term *twill damask* usually refers to these damask-like uses of the contrast between *warp-* and *weft-float faces* (see also *satin damask*, p. 112, and discussion of terms, pp. 132 ff.). Allover patterning produced by the same means (particularly small alternating squares) is often referred to as *diaper* or *diaper weave* (see p. 136 for the term). The *dissimilarity* of the two faces is also used for more purely textural effects – for example, when the two faces are alternated in very narrow bands to make the surface of a fabric alternately concave and convex (often simply called 'cording' but probably better described as 'turned-twill cording').

VARIATIONS OF UNEVEN TWILL

The variations of *uneven-twill weaves* produced by interrupting the continuity and reversing the direction of the diagonals are analogous to similarly produced variations of *even-twill weaves*, although the *dissimilarity* of the two faces of *uneven twill* entails effects that vary from those found in the corresponding variations of *even twill*.

HORIZONTAL HERRINGBONE In *horizontal herringbone*, even or uneven, the regular interlacing order of the *weft* is not affected by changes in direction of the diagonals, but that of the *warp* is. In *even twills*, these variations of warp interlacing are *identical* on the two faces; in *uneven twills* they occur only on the *warp-float face* (figs. 152, 153, 154).

On the *weft-float face*, with a basic interlacing order of 3/1, for example, the 'over-one' interlacing of the warp is unaltered by a reversal of diagonals either *symmetrical* (figs. 150 and 151) or *staggered*.

On the *warp-float face*, if the reversals are *symmetrical*, the interlacing order of half the warps as well as that of all the wefts will be unaffected by the changes of direction. Of the remaining warps, half float over five wefts, half over only one (see figs. 152 and 153). Since the lengthening of warp-float spans occurs only on the *warp-float face*, only that face is marked by the horizontal 'wales' typical of *even warp-faced horizontal herringbone* (fig. 126, p. 96).

NOTE: that the diagonals of a *2/1 twill* can be reversed but they cannot be broken, and consequently the reversals in *2/1 horizontal herringbone* are necessarily *symmetrical*. In other words, *broken twill* and *staggered reversals* both involve omitting one from the regular order of the diagonal progression of floats. But in *2/1 twill*, with the diagonal progression composed of only three different float arrangements, omitting one in one diagonal series means moving directly into the opposite series, and thus reversing the diagonal with a *symmetrical reversal*.

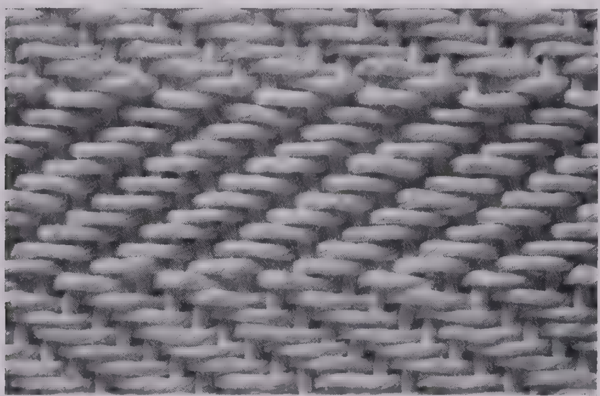


FIG. 150 The *weft-float face* of a *symmetrical 3/1 horizontal herringbone*.

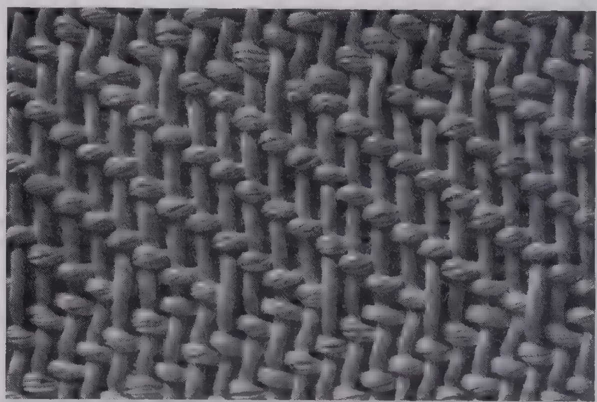


FIG. 152 The *warp-float face* of a *symmetrical 3/1 horizontal herringbone* (opposite face of fig. 150).

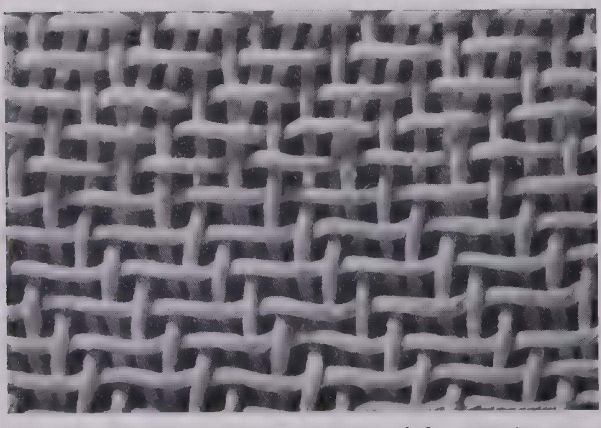


FIG. 151 Diagrammatic construction of fig. 150 (opposite face of fig. 153).

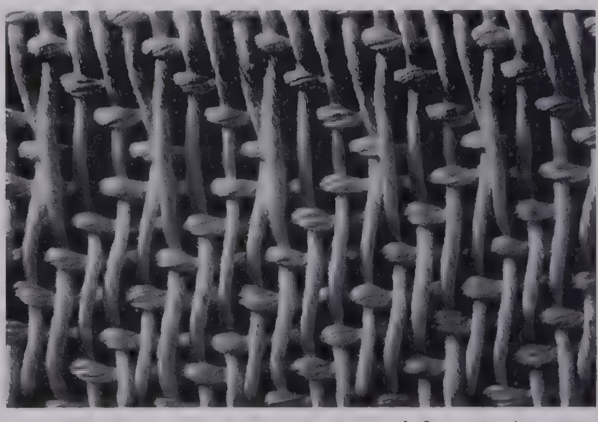


FIG. 153 Diagrammatic construction of fig. 152 (opposite face of fig. 151).

When the reversals in *3/1 horizontal herringbone* are *staggered*, none of the warps maintain the 3/1 order on the *warp-float face*; at the change of direction alternate warps float over four wefts, the intervening ones over two. These long and short floats occur in pairs and the pairs are staggered along the lines of reversal (fig. 154). If the weave is *warp-faced*, the characteristic horizontal 'wales' on the *warp-float face* will be formed by the long floats of the staggered pairs and will appear dovetailed. The counterpart of this offset alignment can be seen in the lengthened weft floats on the *weft-float face* of *vertical herringbone* (fig. 164, p. 105).

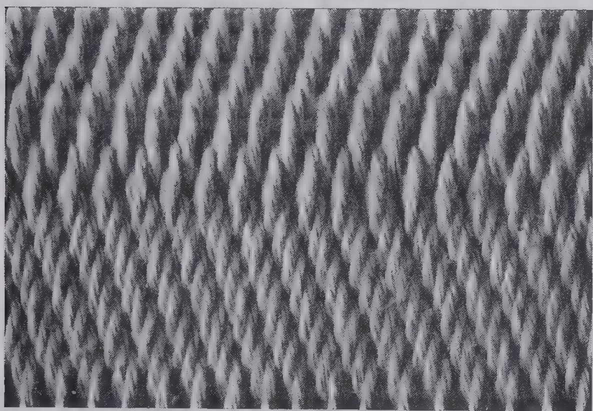


FIG. 154 The *warp-float face* of a *staggered 3/1 horizontal herringbone*, showing the dovetailed 'wales.'

BROKEN TWILL It was noted (p. 95) that the structure often referred to as *broken twill* is in effect a succession of *staggered* reversals of diagonals. If *staggered reversals* occur after every two passages of the weft in *3/1 twill*, the diagonals are broken and reversed without altering the 3/1 interlacing order of either warp or weft (see figs. 155-158).

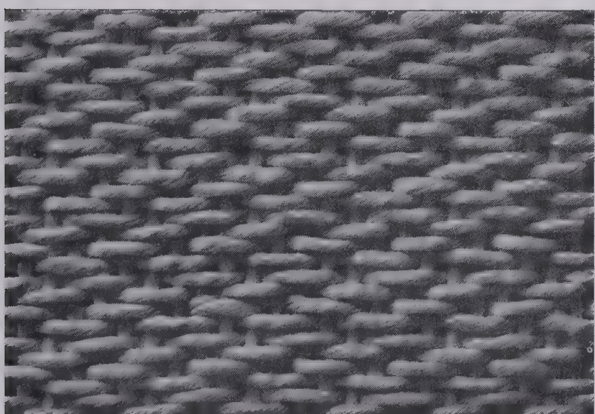


FIG. 155 The *weft-float face* of a *3/1 broken twill*.

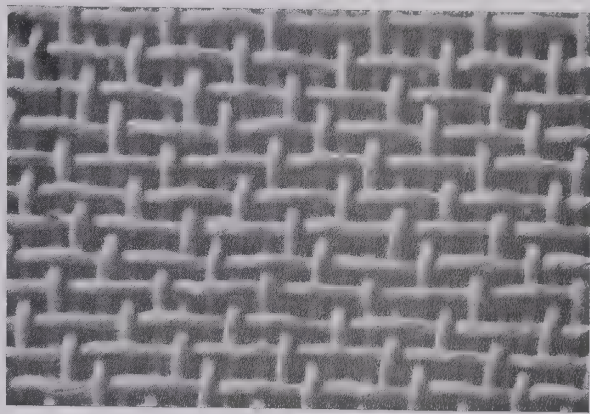


FIG. 156 Diagrammatic construction of fig. 155 (opposite face of fig. 157).

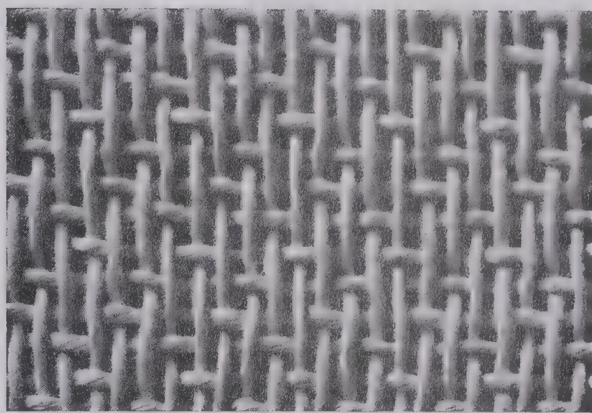


FIG. 157 Diagrammatic construction of fig. 158 (opposite face of fig. 156).

NOTE: that a comparison of this *3/1 broken twill* with *4/1* and *7/1 satin-weave* structures (pp. 108 ff.) will help to explain why *satin weave* is often defined as 'a kind of broken twill' and why this type of *broken twill* is sometimes called 'irregular satin.'

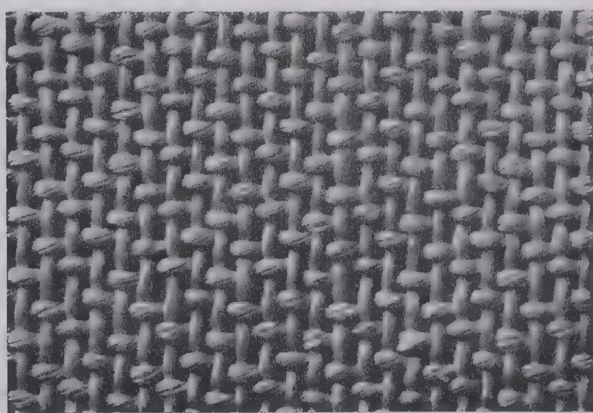


FIG. 158 The *warp-float face* of a *3/1 broken twill* (opposite face of fig. 155).

VERTICAL HERRINGBONE It was noted (p. 95) that the structures of *vertical* and *horizontal herringbone twills* are exact counterparts save for the interchange of interlacing order between warp and weft, and the consequent vertical instead of horizontal axis of the 'herringbone' pattern. In terms of structure, what is said of the *weft* of horizontal herringbone is applicable to the *warp* of vertical herringbone, and vice versa. In *vertical herringbone,* it is the order of *warp* interlacing that is unchanging, the *weft* order that varies when the diagonals are reversed; and when the twill is *uneven* it is on the *weft-float face* that the variations of weft order occur.

Thus on the *warp-float face* of *3/1 vertical herringbone* the only thing that varies is the direction of the diagonals. Warps consistently float over three wefts and wefts consistently 'bind' only one warp at a time, whether the reversals of direction are *symmetrical* (figs. 159 and 160) or *staggered* (fig. 161).

Variations in the weft-interlacing order occur on the *weft-float face* and differ according to the type of reversal. *Symmetrical reversals* affect only the order of alternate wefts, half of which float over five warps, half over only one (see figs. 162 and 163).

Staggered reversals cause all wefts to depart from

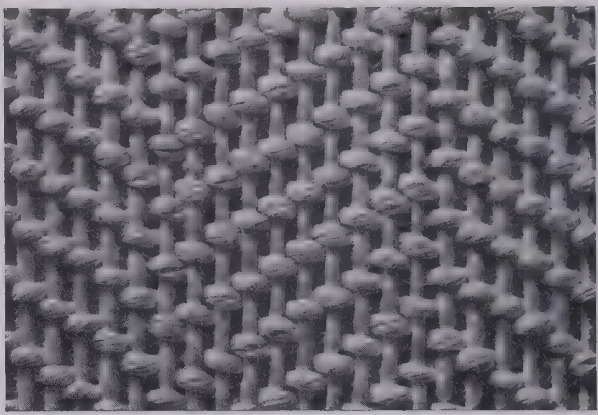


FIG. 161 The *warp-float face* of a *staggered 3/1 vertical herringbone* .

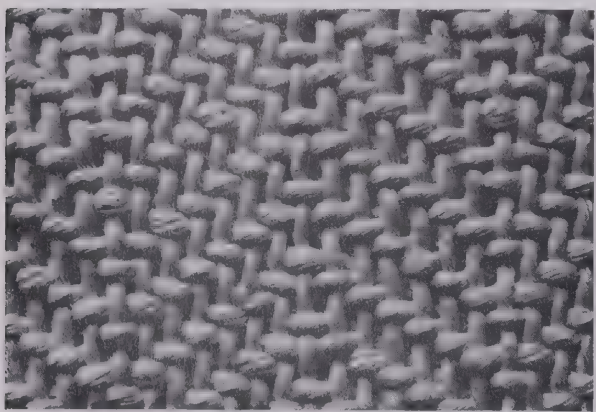


FIG. 159 The *warp-float face* of a *symmetrical 3/1 vertical herringbone* .

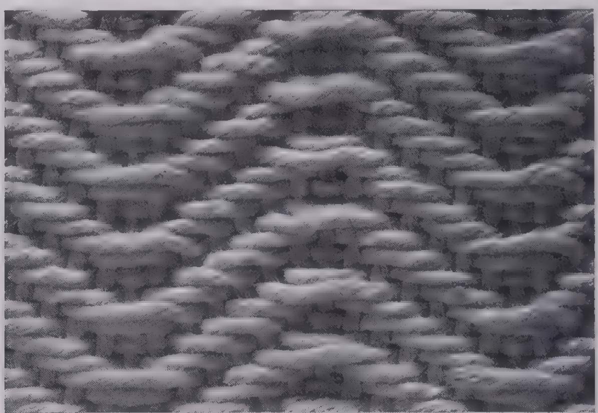


FIG. 162 The *weft-float face* of a *symmetrical 3/1 vertical herringbone* (opposite face of fig. 159).

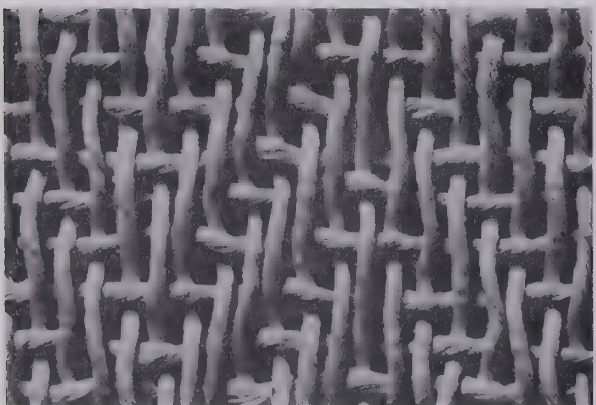


FIG. 160 Diagrammatic construction of fig. 159.

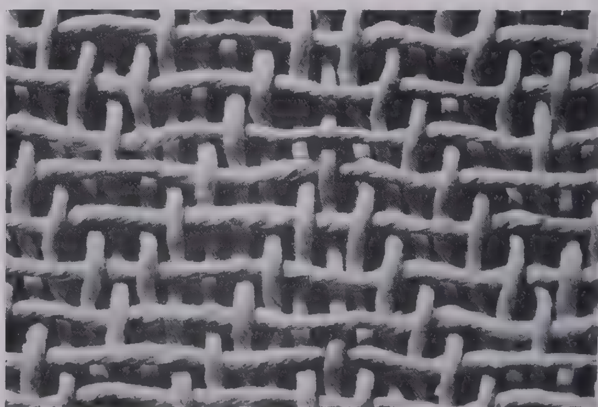


FIG. 163 Diagrammatic construction of fig. 162 (opposite face of fig. 160).

their regular order on the *weft-float face* (alternate ones float over four warps, the others over two, as in fig. 164), and since the vertical alignment of the pairs of lengthened floats is offset, vertical 'wales' will appear dovetailed (like their counterparts in fig. 154, p. 103) if the weave is *weft-faced.*

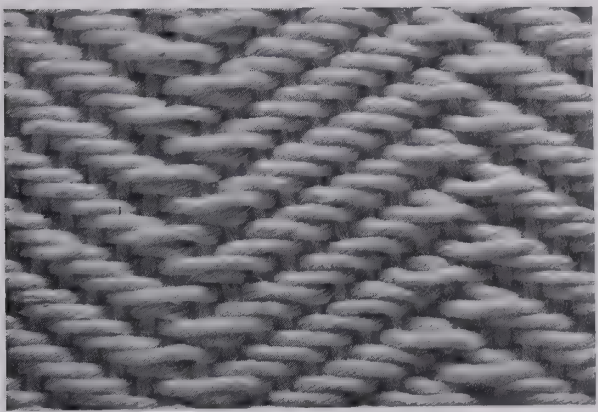


FIG. 164 The *weft-float face* of a *staggered 3/1 vertical herringbone,* showing the offset alignment of the lengthened floats (opposite face of fig. 161).

DIAMOND TWILL Inasmuch as *diamond twills,* with diagonals reversing both ways, combine the structural characteristics of *horizontal* and *vertical herringbone twills,* in a *3/1 diamond twill* only the 'over-one' passages of warp on the *weft-float face* (figs. 165 and 166) and of weft on the *warp-float face* (figs. 167 and 168) will remain constant throughout the structures. As in the component *herringbone twills,* the vertical alignment of the lengthened weft floats on the *weft-float face* is emphasized when the weave is *weft-faced,* the horizontal alignment of warp floats on the *warp-float face* when the weave is *warp-faced.*

FIG. 165 The *weft-float face* of a *symmetrical 3/1 diamond twill.*

Staggered reversals will, of course, offset the vertical alignment of lengthened weft floats on the *weft-float face* (fig. 166) and the horizontal alignment of lengthened warp floats on the *warp-float face* (fig. 167) as in the component *herringbone twills* (fig. 154, p. 103, and fig. 164).

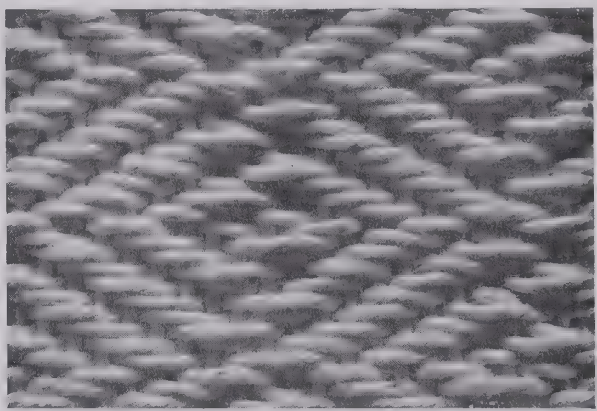


FIG. 166 The *weft-float face* of a *staggered 3/1 diamond twill.*

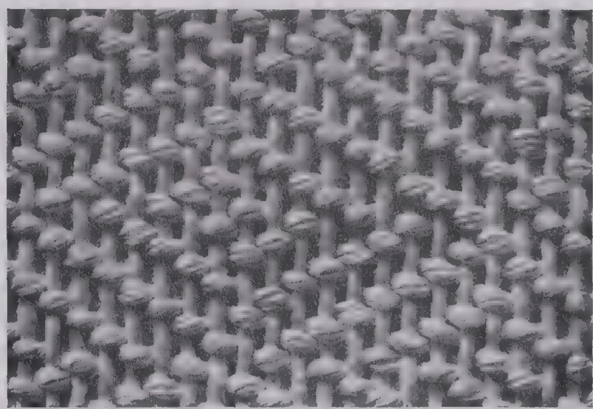


FIG. 167 The *warp-float face* of a *staggered 3/1 diamond twill* (opposite face of fig. 166).

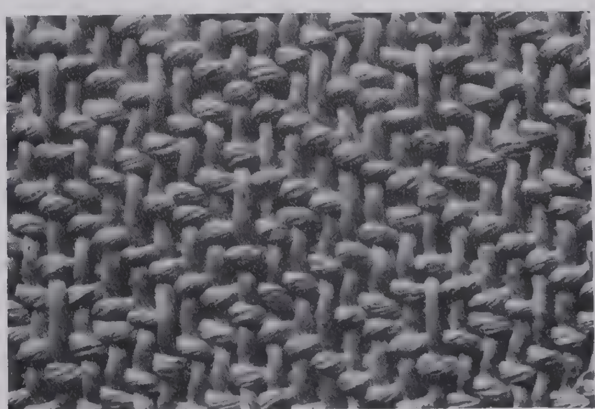


FIG. 168 The *warp-float face* of a *symmetrical 3/1 diamond twill* (opposite face of fig. 165).

NOTE ON ELABORATIONS OF TWILL VARIATION

The two main principles of *twill variation* and the interaction of one type of variation on the other have been illustrated on the preceding pages. The variations are classified and discussed there in terms of the two major variable factors of the twill type of structure, namely, the ratio of float spans and the direction of the diagonals. We saw that in terms of float-span ratio *twill weaves* are basically either *even* or *uneven*; and that the direction of the diagonals can be reversed either horizontally, vertically, or both. We also saw something of the reciprocal action between the two major types of variation, and some incidental possibilities of diversity in the spacing and structure of the reversals. Although the possibilities of further elaboration and diversity based on the same principles defy even simple enumeration, it can be said that, in general, increased diversity of float-span ratios leads to *combined twills*, and diversified use of the basic directional changes, to more elaborate geometrical 'figuring.'

COMBINED TWILLS Much diversity of float-span ratio can be achieved by *combining* different *even* and/or *uneven* twill orders in one order of warp-weft interlacing. In its simplest form, a *combined twill* exhibits the two (or more) twill orders of which it is made up in parallel diagonals of different widths. For example, by combining 3/1 with 2/2, a twill structure can be produced in which the over-3-under-1-over-2-under-2 interlacing creates parallel diagonals alternately wide and narrow. Twills combined in this way (and others, more elaborately combined) are *simple weave* constructions usually referred to as *combined twills*, but sometimes lumped with other twill variations under the term *fancy twill* (see pp. 129 f.).

'FIGURED TWILLS' Although all twills are, in a sense, 'patterned' or 'figured'– if only by continuous diagonals – elaborately contrived figuring can also be created by manipulation of the simple one-way and two-way direction reversals which are basic to all twill patterning. Terms for elaborations of twill patterning are many and various, but the general term *figured twill* can be used to distinguish elaborations from the more fundamental forms of twill patterning such as *herringbone* and *diamond*. (For use of the terms *figured* and *patterned*, see p. 123.)

VARIANT USE OF SIMPLE TWILL

TWILL TAPESTRY The mosaic-like patterning characteristic of *tapestry weave* (pp. 78 ff.) can be produced in any of the *simple twill weaves* much as it is in *plain weave*. The use of discontinuous wefts to vary the weft color and create distinct color areas that are identical on the two faces of the fabric is essentially the same, although the basic differences between *twill* and *plain-weave* structures lead to certain differences of detail and emphasis. While the nature of the *twill* structure imposes limitations that are not encountered in the use of *plain weave*, it also permits considerable variety of surface patterning. (The patterning of the twill weave is sometimes correlated with the shaping of color areas, sometimes not.) Nevertheless *twill* has never been as widely used as *plain weave* for tapestry-patterning; nor has *twill tapestry* ever been extensively employed for pictorial effects.

Although *twill* can be woven, as *plain weave* usually is in *tapestry*, with the weft completely covering and concealing the warp, the definition of areas of weft color is less dependent on predominance of weft over warp than in *plain weave*. The continuity of color produced by the progressively overlapping floats of *twill* makes changes of weft color visually effective whether or not the weft outnumbers and overshadows the warp; whereas, in the simple alternation of *plain-weave* interlacing, the color of the weft is consistently broken into and diffused by that of the warp if the warp is not concealed.

In *even twill*, as in *plain weave*, the extent of weft predominance and, accordingly, the effect of changes of weft color are the same on both faces of the fabric; but if the twill is *uneven*, the effectiveness of changing weft colors will be more marked on one face than on the other (unless the weft completely conceals the warp). When warp and weft counts are nearly equal, the *weft-float face* of *uneven twill* (having a surface made up largely of weft floats) can be even more effectively patterned by changes of weft color than either of the *identical* faces of *even twill*; but the *warp-float face* will be correspondingly dominated by warp color, and the effect of changes of weft color proportionately diminished.

Since the effectiveness of tapestry-patterning is less dependent on weft-predominance in *twill* than in *plain weave*, *twill* is especially useful for a fabric in which small areas of tapestry-woven pattern are set in large unpatterned areas of a relatively balanced weave. The necessity of co-ordinating areas of different densities, so often encountered in a comparable use of *plain weave*, is practically eliminated by the use of *twill*. On the other hand, *twill weaves* are less easily manipulated to fit the patterning requirements of tapestry weaving; exact delineation of shapes is more difficult; and creation of well-defined margins between color areas is more complex.

Since turning successive twill wefts back round the same warp entails breaking into the regular diagonal alignment of floats, *slit* (or un-joined) vertical margins are not feasible in *twill tapestry*. Nor is *dovetailing* – although the smooth face of *double interlocking* (fig. 169) may look misleadingly like it. Effective definition of boundaries can best be secured by interlocking the wefts from adjacent areas. *Single interlocking*, however, does not entirely eliminate slippage (due to the float structure of *twill*) and the consequent displacement of 'joins,' and perhaps for that reason is seldom found in *twill tapestry* except when the wefts are very firmly compacted or when pattern outlines are largely diagonal. *Double interlocking* (figs. 169 and 170) provides the most firmly secured 'join' between areas and is, in fact, almost essential to clear definition of a vertical margin. *Twill-tapestry* wefts are interlocked in the same way as the wefts in *plain-weave tapestry* (p. 80), and *double interlocking* is marked by the same ridged transposition of colors on one face (fig. 170) as when the tapestry is *plain woven* (figs. 103 and 104, p. 81).

NOTE: that one of the outstanding developments of the use of *twill* for tapestry-patterning is found in the justly famous 'Kashmir shawls.' Various general references to them mention *2/1, 3/1*, and *2/2 twill weaves*, but specific descriptions, and analysis of the fabrics, indicate that the *twill weave* of the shawls is quite consistently 2/2, with *double interlocking* of wefts. (The weft count is usually higher than the warp count but the shawls are seldom if ever completely *weft-faced*.) A second, far less standardized but nevertheless remarkable, development of *twill tapestry* is found in pre-Spanish aboriginal cotton weaving from the American Southwest. The weaving is marked by the use of numerically different twills (2/1, 2/2, 3/3, and so on) and many variations of the twill order (not only *herringbone, zigzag*, and *diamond*, but also more varied combinations of twill diagonals). There is great variety in the degree of weft-predominance (ranging from balanced to weft-faced structures) and further variety in the relationship of the tapestry- or color-patterning to the twill- or weave-patterning. Wefts are interlocked, and as far as I can tell from my own investigations and from published accounts, the interlocking is consistently *single*.

In general, as compared with the more usual *plain-weave tapestry*, it may be said that examples of *twill tapestry* show more frequent use of equal or nearly equal warp and weft count, more consistent interlocking of wefts, more *dissimilarity* between faces, and more diversity of weave structure and pattern. There seems to be no evidence of purposive use of non-horizontal (or 'eccentric') wefts in *twill tapestry*.

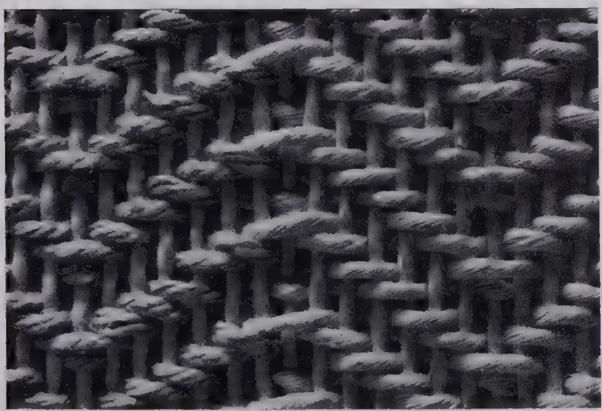


FIG. 169 Diagrammatic construction of *double interlocking* of wefts to form a vertical margin in *2/2 twill tapestry (vertical herringbone)* – smooth face of the interlocking.

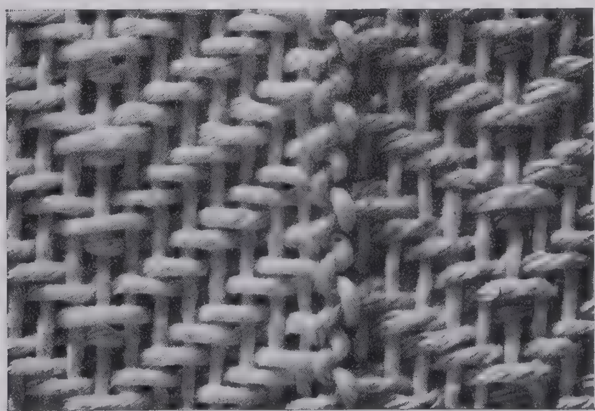


FIG. 170 Opposite face of fig. 169, showing ridge formed by *double interlocking* of wefts in *2/2 twill tapestry (vertical herringbone)*.

B. SATIN WEAVES

In textile terminology, the word *satin* is used in two basically different ways: to refer to a type of woven fabric characterized by a smooth lustrous surface and a silky appearance (even if not actually made of silk); and also to designate a type of weave characterized by long floats of one set of elements, and more or less evenly distributed single 'ties' of the other, on each face (warp-floats on one face, weft-floats on the other). Although *satin weave* undoubtedly owes its extensive development and much of its use to the fact that it can provide the lustrous smooth-surfaced quality which identifies the fabric known as *satin*, identification of the *weave* is not contingent on the presence of that quality. *Satin weave* can be used with quite different effect.

The statement that there are three 'basic weaves,' *plain*, *twill*, and *satin*, has been repeated so often that it has come to be rather widely accepted as authoritative – requiring neither explanation nor substantiation. The statement has obviously appealed to many as a useful way of simplifying the classification of weaves; but unless qualified, it seems essentially misleading and its usefulness open to question. By the enumeration of 'three basic weaves' it is implied (and sometimes stated) that they are the ones from which all others are derived; yet it is impossible to make any extended study of fabric structures without encountering some (*gauze weaves*, for example) which cannot be said to derive from any of the three. Moreover, the implied co-equality of the three is also open to question. The frequency with which *satin weave* is described in terms of *twill* (note the use of an expression like 'a kind of broken twill' for *satin*, or 'a fancy twill,' 'irregular warp twill,' 'a rearranged twill') and certain *twills* in terms of *satin weave* (e.g. 'broken, or satin, twill' and '4-end satin, or broken twill') strongly suggests that the structures of *satin* and *twill* belong to the same basic class of weaves.

Satin weave is a *simple float-weave* structure. It is like *uneven twill* in having *dissimilar* faces, with warp-floats on one face and weft-floats on the other; but differs in that the diagonal alignment of floats is intermittent. The points at which floats are bound are dispersed so that successive wefts never bind or are bound by adjacent warps. The pattern of the dispersal of binding points can vary, as well as the float span; but the binding of floats is always single.

It has been noted (p. 102) that in a *2/1 twill* the diagonal progression can be reversed but cannot be broken, whereas in *3/1 twill* it can be broken in such a way that each point of binding is contiguous with only one other (see figs. 156 and 157, p. 103). In *4/1 twill*, with five warp groupings, it is possible to break the diagonal progression at every weft passage so that there are no contiguous points of binding, and this constitutes a *4/1 satin weave*. Comparing the structure of the *4/1 twill* in figures 171 and 173 with that of the *4/1 satin weave* in figures 172 and 174, it can readily be seen that on the *warp-float face* of both (figs. 171 and 172) the order of weft-interlacing is over-1-under-4 and the order of warp-interlacing over-4-under-1. However, in the *twill* (fig. 171) each successive weft binds the next adjacent warp, whereas in the *satin weave* (fig. 172) at least one warp intervenes. The *weft-float faces* (figs. 173 and 174) are similarly related.

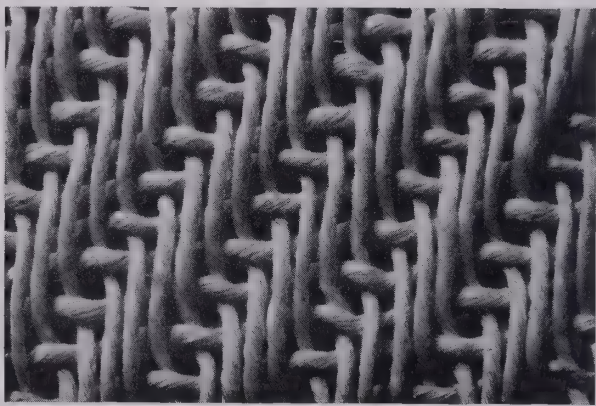


FIG. 171 Diagrammatic construction of the *warp-float face* of a *4/1 twill*.

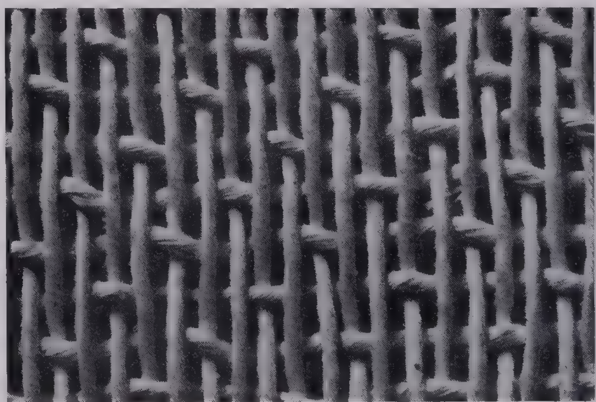


FIG. 172 Diagrammatic construction of the *warp-float face* of the regular *4/1 satin weave* in figs. 175 and 177.

Although intermittence of the diagonal alignment of floats is a primary characteristic of the structure of *satin weave*, it does not in itself create the smooth, unmarked surface appearance usually associated with the weave. Both the quality of the elements and the ratio of predominance of one set are additional factors in the final effect. But regardless of qualitative variation, the effect produced on the *warp-float face*, when warp and weft elements are identical in quality but the *warp* outnumbers the *weft*, can be seen in figure 175 and contrasted with the effect when the *weft* is predominant (fig. 177). The way the predominant weft affects the *weft-float face* is shown in figure 176.

NOTE: that while the 'diagonal effect' which tends to develop in *satin weave* can be subdued, it is apparently impossible to obliterate it in regular *4/1 satin weave*, which is sometimes designated 'satin twill.'

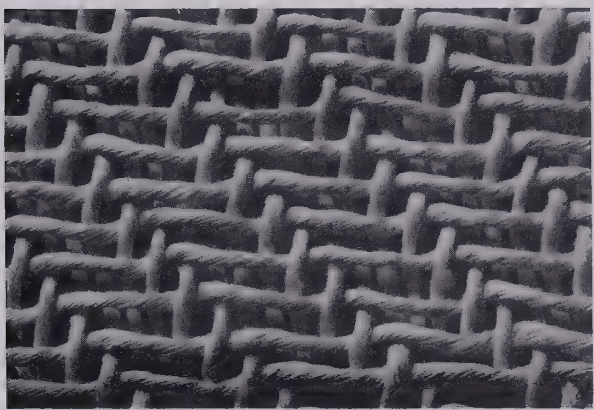


FIG. 173 Diagrammatic construction of the *weft-float face* of a *4/1 twill* (opposite face of fig. 171).

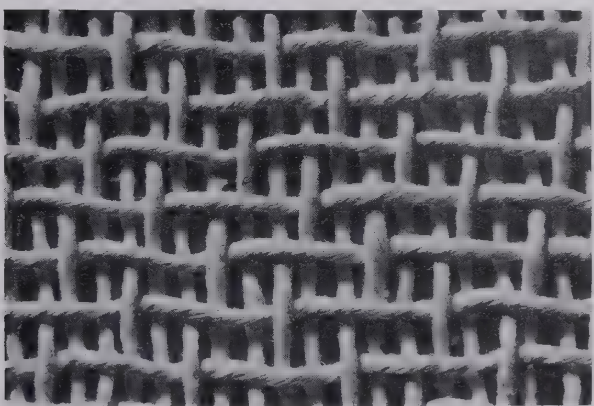


FIG. 174 Diagrammatic construction of the *weft-float face* of the regular *4/1 satin weave* in fig. 176 (opposite face of fig. 172).

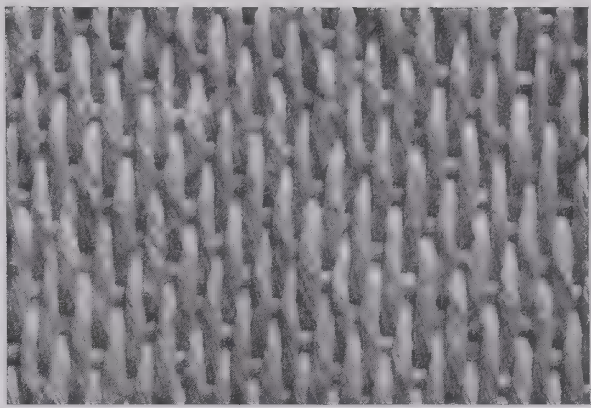


FIG. 175 The *warp-float face* of a *4/1 satin weave* with *predominant warp.*

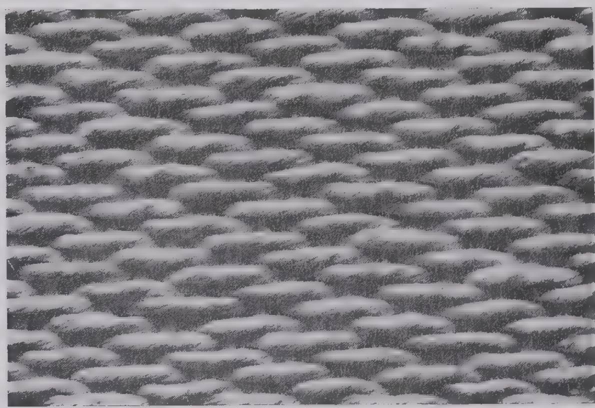


FIG. 176 The *weft-float face* of a *4/1 satin weave* with *predominant weft* .

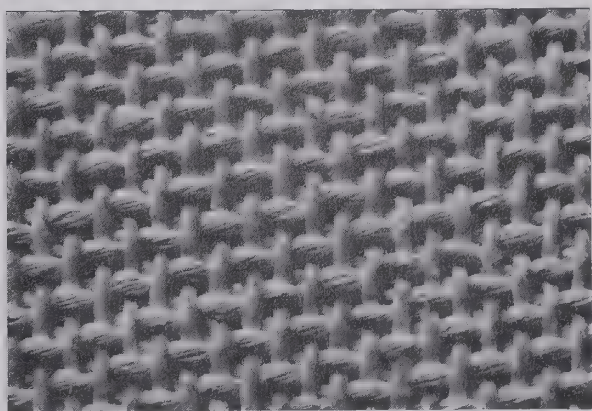


FIG. 177 The *warp-float face* of a *4/1 satin weave* with *predominant weft* (opposite face of fig. 176).

NOTE: that one face of a *satin weave* (e.g. fig. 177) may bear a superficial resemblance to *plain weave* – which may explain (but does not justify) those puzzling descriptions of simple fabric structures as 'satin weave on one face and plain weave on the other.'

An increase in the number of different sheds used for *satin weave* increases both the numerical span of the floats and the proportionate space between binding points. The greater the increase, the greater the possibilities of varying the distribution of binding points and the more unmarked the surface can be made. *Satin weaves* are constructed with floats spanning from four to fifteen or more elements and with many different patterns of distribution, some *regular*, some *irregular*. The *4/1 satin* structure on pages 108 and 109 and the *7/1* structure in figures 178 through 183 are both typical examples of the uniform spacing of binding points required for what is termed *regular satin weave*. Something of the relationship of the numerical span of floats to the spacing of binding points and the creation of a smooth, unmarked surface can be seen by comparing various aspects of the two structures. Like the *4/1 satin weave*, the *7/1* weave is illustrated here by a single structure. No variation in the distribution of binding points is shown -- only variation in the spacing of elements.

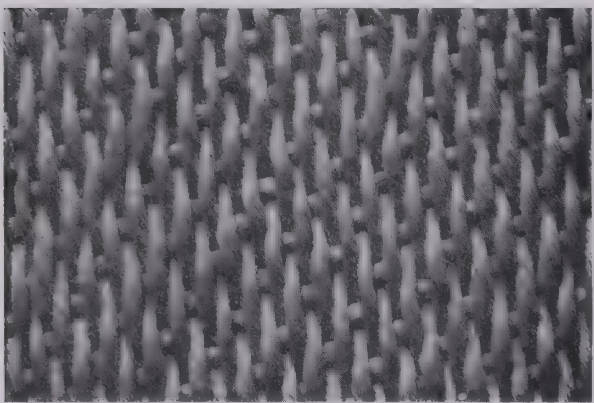


FIG. 178 The *warp-float face* of a *regular 7/1 satin weave* -- slightly higher warp than weft count .

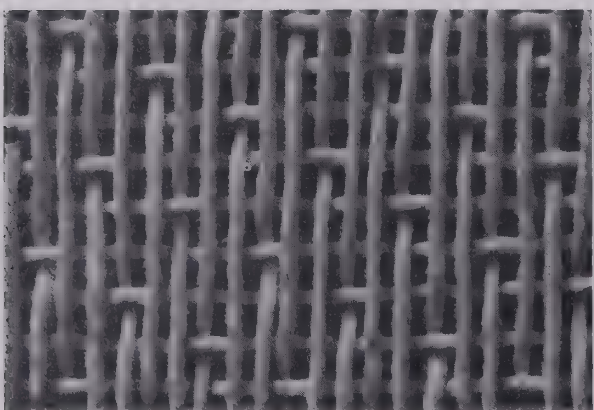


FIG. 179 Diagrammatic construction of fig. 178.

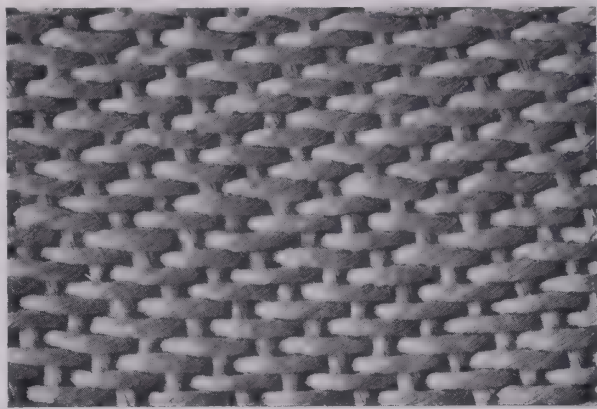


FIG. 180 The *weft-float face* of a *regular 7/1 satin weave* (opposite face of fig. 178).

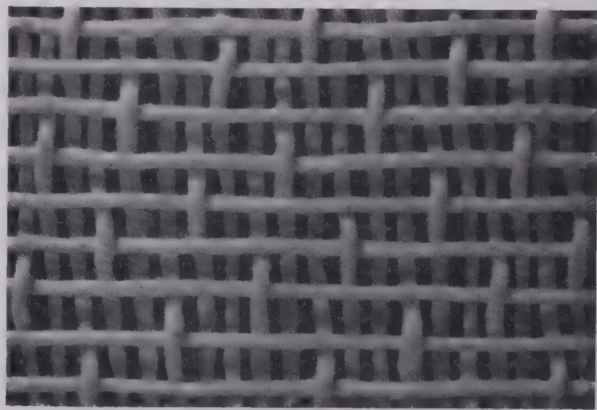


FIG. 181 Diagrammatic construction of fig. 180 (opposite face of fig. 179).

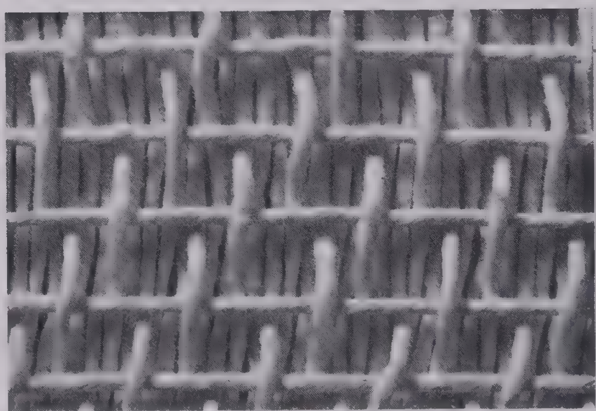


FIG. 182 Diagrammatic construction of fig. 180 with only the wefts schematically spaced, and with the warps numerically *predominant* (opposite face of fig. 183).

The effect of predominance of either warp or weft differs somewhat in *satin weave* from that in any of the other weaves discussed so far. The dispersal of binding points makes it possible to construct a fabric in which one face appears to be made up en-

tirely of floats of the predominant element while the opposite face appears relatively balanced. If, for example, a *7/1 satin weave* has a considerably higher warp than weft count, the length of the warp floats, and the dispersal of the points at which they are bound by less numerous wefts, combine to give the warps sufficient 'play' to allow them to more or less mask the brief and relatively infrequent appearances of weft on the *warp-float face* (fig. 183). On the *weft-float face* (fig. 182), although the numerical span of the weft floats is not affected by the high warp count, their relative length is so reduced that neither warp nor weft appears to dominate.

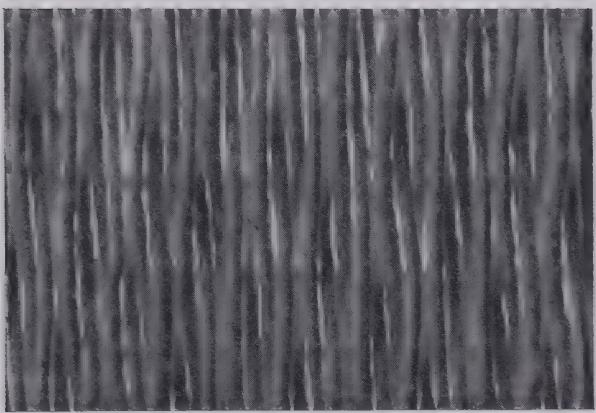


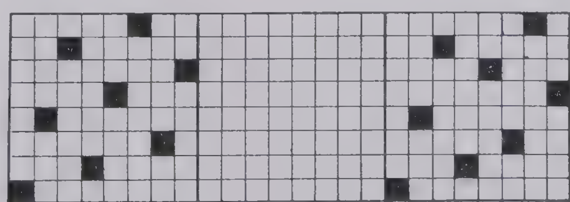
FIG. 183 The *warp-float face* of fig. 182. The binding points are obscured by the warp floats, the spaced wefts revealed only by the shadows they cast when the construction is lighted from behind.

It is often assumed that the term *satin weave* refers specifically to the variety in which the characteristically smooth, unbroken 'satin' surface is produced on the *warp-float face* by closely spaced and numerically *predominant warps*, and the term *sateen* to that in which the 'satin effect' is produced by *predominant wefts* on the *weft-float face*. (For other uses of the term *sateen*, see pp. 137 f.) However, since it is generally realized that the two forms differ not in weave structure but in orientation of the structure in the fabric, it is more usual to find a *satin weave* that has the 'satin effect' on the *warp-float face* referred to as a *warp satin*, and its converse called a *weft satin*. At the same time it should be noted that, in so far as the terms *warp* and *weft satin* imply predominance of warp or weft elements, they are not applicable when there is a 'satin effect' on both faces of a *satin weave* (see figs. 178 and 180).

VARIATION: ***Irregular satin weave***

A *satin weave* in which the binding points are unevenly distributed (whether or not any are contiguous) is said to be *irregular*. In most *irregular satin weaves* the order of interlacing (and therefore the float-span ratio) is the same throughout; the irregularity is to be found in the 'intervals' between the binding points of adjacent elements. Although subject to differences of interpretation, the term *interval*, as applied to *satin weave*, usually refers to the smallest number of elements intervening between the points at which adjacent elements are bound. If the *satin weave* is *regular*, the 'interval' does not vary and can be simply stated (e.g. the interval in fig. 172 is 1, in fig. 179, 2); but if *irregular*, the different intervals must be listed in order.

The numerical designation of a *satin weave* states the ratio of the float span (4, 5, 6, 7, or whatever it may be) to the binding or 'tie' (which is always 1). This describes a specific order of interlacing (e.g. 7/1) but gives no information about the distribution of binding points. The general type of distribution can be stated as *regular* or *irregular*; but a specific pattern of distribution can be expressed more precisely in diagram form than in words or sequences of numbers. Simple notation on graph paper of the relative positions of binding points in one 'repeat' of the weave structure (e.g. for *7/1 satin*, 8 threads in each direction) is not easily misconstrued. For example, the distribution pattern of the *regular 7/1 satin weave* illustrated on the opposite page is shown below at *a* (the right-to-left diagonal progression corresponding to that on the *weft-float face* in fig. 174), the pattern of an *irregular 7/1 satin weave*, at *b*.



a. *Regular* b. *Irregular*

NOTE: that although a *regular* distribution of binding points is impossible in *5/1 satin weave*, with any other float span (over 3) the distribution can be either *regular* or *irregular*. The diagonal trend of successive binding points is less apparent when the distribution is *irregular*.

VARIANT USE: *Satin damask*

More or less elaborate patterning produced by 'turning' or 'reversing' a weave structure (i.e. using both aspects of the weave on the same face of the fabric) is characteristic of *damask weaving*. Although the weave may be an *uneven twill* and the patterned fabric referred to as *twill damask* (see p. 101), the word *damask* is more commonly associated with fabrics patterned by the dissimilar faces of *satin weave*. In fact, it is often assumed that, as a technical term, *damask* refers to *satin damask* unless the use of some other weave is specified; whereas actually the term is quite commonly used with various other connotations (see pp. 133 ff.). Often, for example, it is meant to indicate nothing more than that a fabric is patterned by variations of texture rather than color.

If the warp and weft elements differ comparatively little in either size or 'count,' there is about as much 'satin effect' on one face of a *satin weave* as on the other; and the dissimilarity between the faces, like that in *uneven twill*, results largely from the presence of all vertical (*warp*) floats on one face and of all horizontal (*weft*) floats on the other. Light falling along the floats tends to give the surface a flat smooth appearance; striking across them, it tends to emphasize the diagonals. In *damask*, although the structural dissimilarity between *warp-float* and *weft-float* areas (e.g. fig. 184) ensures effective patterning regardless of lighting, the contrast is enhanced or diminished, and the surface appearance considerably altered, by changes in the way the light strikes the fabric.

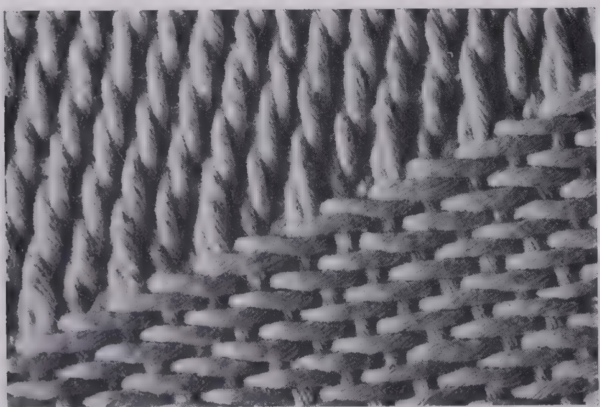


FIG. 184 Contrast between the *warp-float* and *weft-float* faces of a *7/1 satin weave* on the same face of a *7/1 satin damask* (light falling across the fabric).

Inasmuch as the textural contrast between faces is more marked in a *satin weave* that has the 'satin effect' on only one face (as described on p. 111), such a *satin weave* provides greater contrast with which to effect *damask* patterning. In the 'satin-effect' areas, only the predominant element is in evidence (see fig. 183); in the other areas, the single bindings of the predominant set and the floats of the other set are equally visible (see fig. 182). Figures 185 and 186 show the two faces of one small area in a *7/1 satin damask* fabric (magnified approximately x6). Warp and weft are identical in fiber and color (red silk) but not in size. In the *warp-float* areas, the fine warps, which number about 135 to the centimeter, completely mask the presence of bulkier but less numerous wefts (approximately 30/cm.) while in the *weft-float* areas, weft floats and the warps that bind them are equally apparent. Strong light directed across the fabric makes the warp filaments appear lighter in color than the wefts.

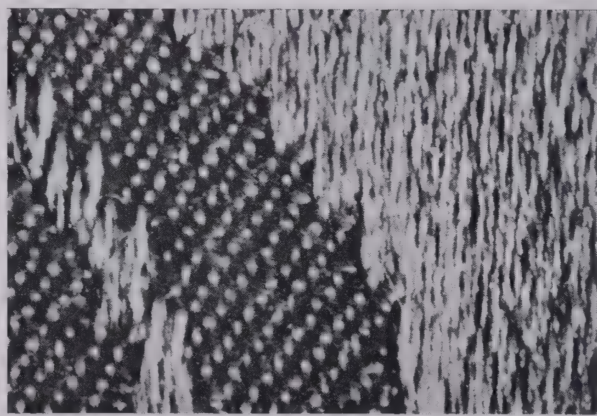


FIG. 185 Detail of red silk *7/1 satin damask* (x6) showing the contrast between *warp-float* and *weft-float* areas when light is directed across the fabric.

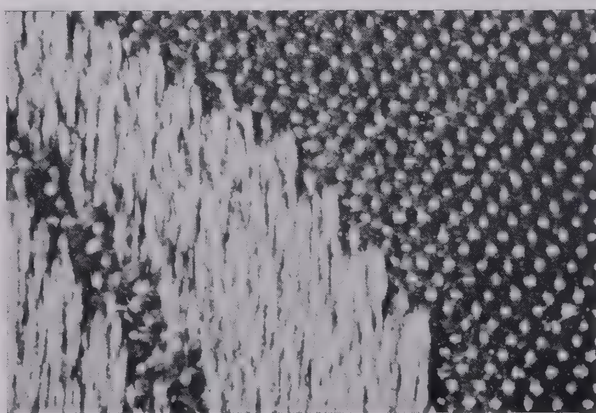


FIG. 186 Mirror image of the opposite face of fig. 185 (*warp-float* and *weft-float* areas interchanged).

C. FLOAT WEAVES DERIVED FROM PLAIN WEAVE

It was noted on page 92 that in addition to *twill* and *satin weaves,* which can be distinguished by well-defined systems of float organization, "there are diverse *simple float-weave* structures marked . . . by alternation in the alignment of floats or by some rectangular, rather than diagonal, arrangement." Many of these weaves retain evidence of *plain-weave* derivation and are marked by multiple and often 'mixed' orders of interlacing.

While it is sometimes maintained that all other *float weaves* can be shown to be derived from *twill,* other points of view lead to the assertion either that any *float weave* that lacks the progressive diagonal alignment of floats typical of *twill* (or the intermittent diagonals of *satin*) should be considered a 'variation' of *plain weave,* or that the 'binding' of floats that are alternated in alignment is a 'plain-weave binding.' Usually, however, *simple float weaves* that are not specifically classified as *twill* or *satin* are discussed in terms of the special fabric characteristics for which they are used. These characteristics include: longitudinal or transverse ribbing; *warp-* or *weft-float* surfaces; texture patterning (including openwork), either allover or in dispersed areas; patterning on a background of a different weave; and, if the weave has *dissimilar* faces, damask-like patterning by means of its two aspects. There are numerous terms with which to designate weaves used for one or another of these purposes, but none with which to identify the weaves themselves without reference to the effects they produce. A study of different systems of classification and of various informal ways of grouping weaves for purposes of discussion has failed to reveal any general concept of the structures and systems of float-alignment that distinguish these largely non-diagonal *float weaves* as a group.

Being frequently used for patterning of one sort and another, these weaves are often classified under general headings like *figure weaving, pattern weaving,* and *fancy weave* (terms which are variously and indeterminately defined; see pp. 123 f.). The term *Han damask,* on the other hand, is often used to designate one specific use of a specific float weave, namely, patterning in *simple alternating float weave* on a *plain-weave* background (pp. 116 and 120). When used for ribbing, certain non-diagonal float-weave structures may be designated *rep, cord, piqué, cannelé,* and so on. But such terms usually refer specifically to fabrics (see p. 86), often designating *warp-* or *weft-faced* fabrics with ribs formed by warp floats in transverse alignment or by weft floats in longitudinal alignment. Terms like *huckaback, mock leno, spot weave,* and *lace weave,* although variable in usage (see pp. 124 ff.), are likely to refer – as the terms themselves suggest – to *float-weave* fabrics characterized by qualities other than ribbing.

The lack of terms with which to designate their structural characteristics without reference to fabric qualities suggests that these more or less unclassified *float weaves* have been considered more in terms of their latter-day diversity than as diverse developments of one or more prototypes. But since it is in the simplest forms of a weave type that its distinguishing characteristics and its relationship to other types can be most clearly discerned, it is in the earliest discoverable deviations from the rigid formula of *plain-weave* interlacing that the order and extent of deviation is most easily traced and the relationship of various *float weaves* to *plain weave* most clearly seen.

It will be found, for example, that in many *float weaves* there remains sufficient structural evidence of a *plain-weave* origin to suggest that while they are in no sense forms of *plain weave,* they may well be classified as derivatives of it. Even a diagonal alignment of 3-span floats (fig. 187) can be seen in relation to a possible *plain-weave* source as well as in its more obvious relationship to *twill.*

The distinguishing characteristic of the *plain-weave* (1/1) structure is consistent alternation. If one

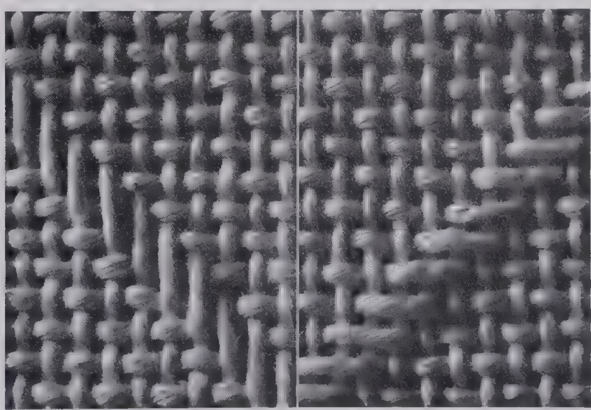


FIG. 187 The two faces of a *plain weave,* each marked by single 3-span floats (either warp or weft) in diagonal alignment, i.e. by a series of single 'skips' in the *plain-weave* interlacing.

of the regular interlacings is 'skipped,' the 1/1 order will be altered at that point, the weft passing over three warps on one face and the warp thus disengaged passing over three wefts on the opposite face. In *plain weave*, then, omission of one regular interlacing will produce reciprocal floats of warp and weft each of which spans three elements of the opposite set. If single float-producing omissions occur in successive passages of both warp and weft, they will be diagonally aligned as in figure 187. (If repeated to the exclusion of all 1/1 interlacing, they will produce *3/1 twill weave*, either *plain*, p. 100, or *broken*, p. 103.) However, if the regular 1/1 interlacing of the *plain weave* is retained in one passage but entirely replaced in the next by a succession of float-producing omissions (i.e. by 3/1 interlacing), *simple-weave* structures with floats alternately aligned on both faces can be produced without additional sets of either warp or weft.

1. ALTERNATING FLOAT WEAVE

One *float weave* which apparently exemplifies minimum deviation from *plain weave* has been widely and variously used. Its seemingly unnamed structure is based on *alternation* – alternation of uniform 3/1 with uniform 1/1 interlacing in both warp and weft, and alternation in the alignment of the 3-span warp floats on one face (fig. 188) and of the 3-span weft floats on the other (fig. 191). This undoubtedly represents an early departure from the *plain-weave* formula and may well be the prototype of many *plain-weave* derivatives.

The derivation is evident in figures 189 and 190. In the transition from a longitudinal area of *plain weave* (*b*) to one of *float weave* (*a*), alternate wefts follow an unvaried and uninterrupted over-1-under-1 interlacing order; those in the other shed of the *plain weave*, by omitting alternate interlacings in the *a* area, create the *float weave*.

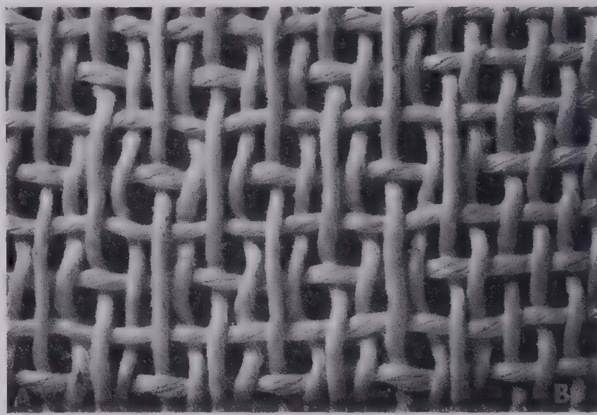


FIG. 189 Diagrammatic construction of (a) the *alternating float weave* in fig. 188 (*warp-float face*), showing the transition from *plain weave* (b).

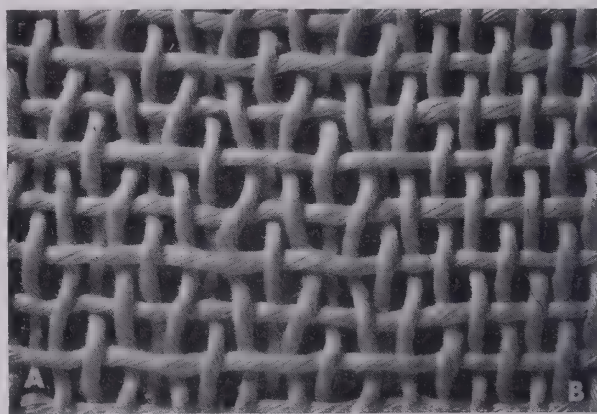


FIG. 190 Opposite face of fig. 189. Transition from (b) *plain weave* to (a) the *weft-float face*, fig. 191.

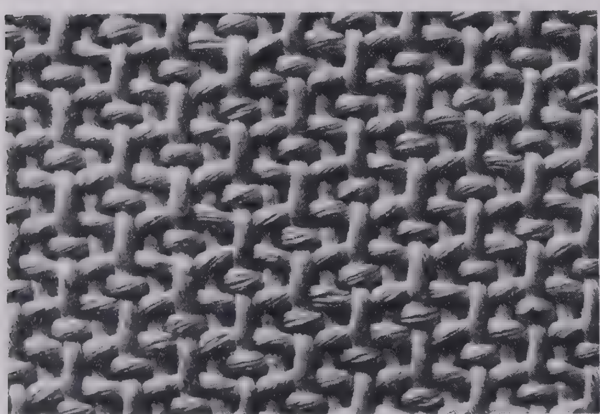


FIG. 188 The *warp-float face* of an *alternating float weave* based on identical 3/1 : 1/1 interlacing orders of warp and weft .

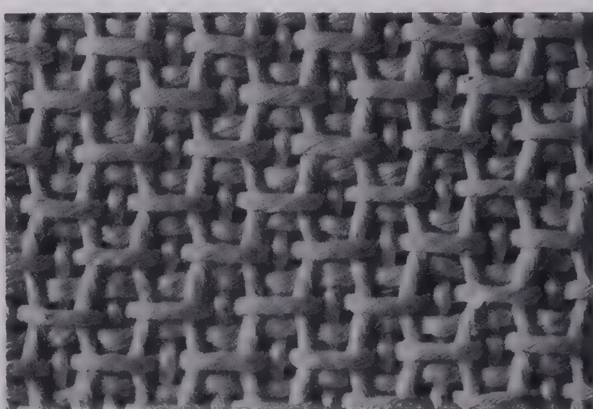


FIG. 191 The *weft-float face* of *3/1 : 1/1 alternating float weave* (opposite face of fig. 188).

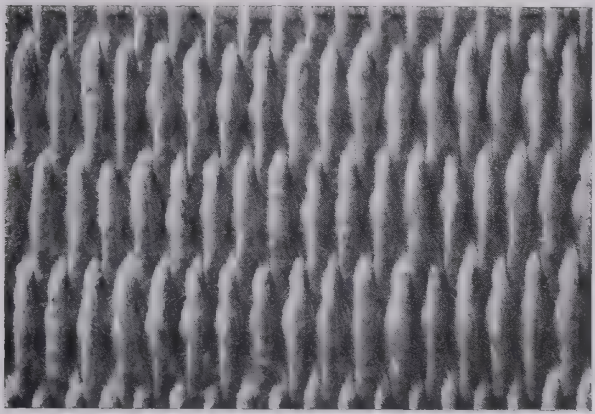


FIG. 192 The *warp-float face* of the *alternating float weave* diagrammed in fig. 189 when the *warps* are *predominant*.

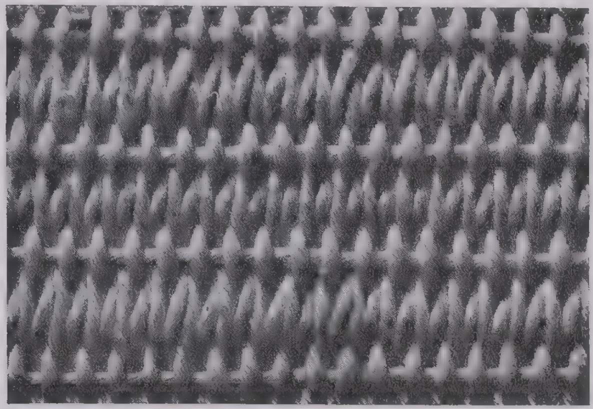


FIG. 195 The *weft-float face* of *alternating float weave* when the *warps* are *predominant*. (Opposite face of fig. 192.)

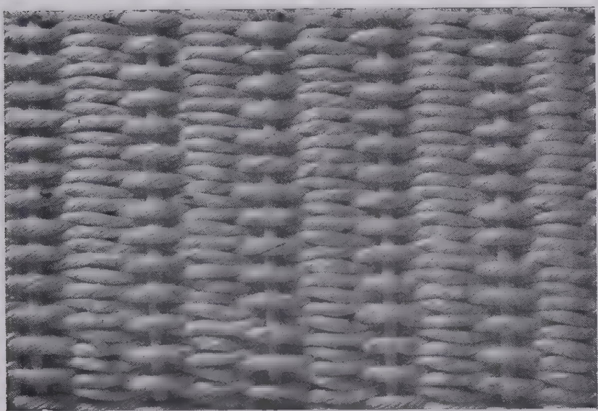


FIG. 193 The *warp-float face* of *alternating float weave* when the *wefts* are *predominant*.

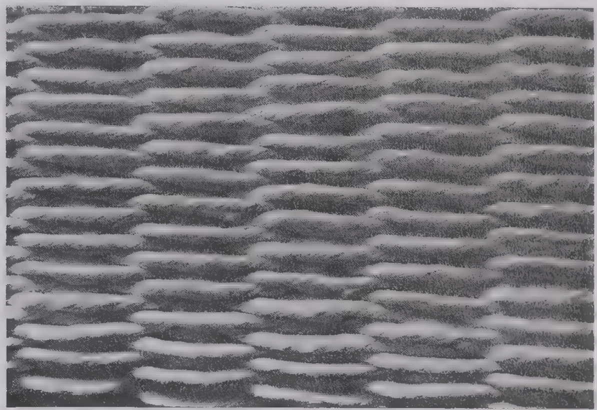


FIG. 196 The *weft-float face* of *alternating float weave* when the *wefts* are *predominant*. (Opposite face of fig. 193.)

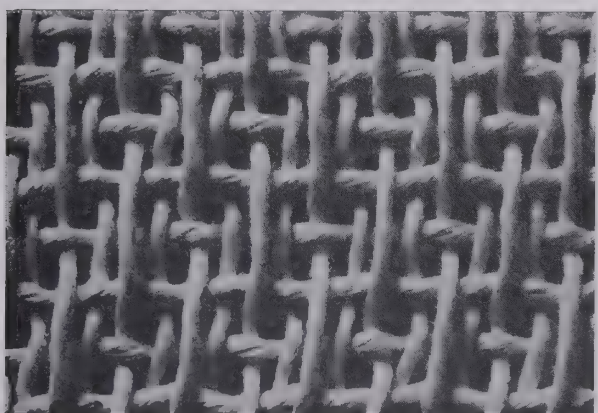


FIG. 194 Diagrammatic construction of the *warp-float face* of the *alternating float weave* in figs. 188, 192, and 193.

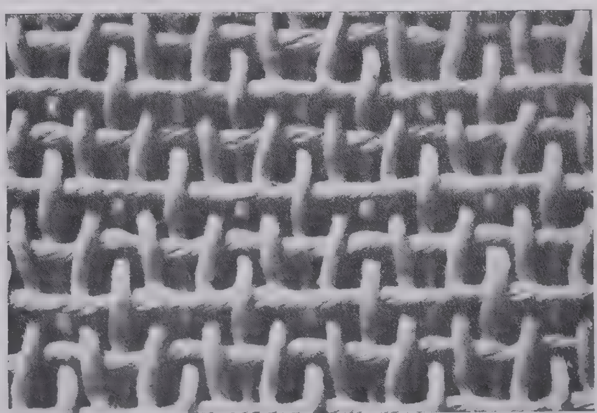


FIG. 197 Diagrammatic construction of the *weft-float face* of the *alternating float weave* in figs. 191, 195, and 196. (Opposite face of fig. 194.)

NOTE: that when, as in this weave, the interlacing orders of warp and weft elements are identical, the effect of a *predominant warp* on the *warp-float face* (fig. 192) is exactly duplicated, except for the direction of floats in the fabric, by the effect of a *predominant weft* on the *weft-float face* (fig. 196); and also that the opposite faces of both (figs. 193 and 195) are similarly correlated.

NOTE: that the concept of this simplest and most regular of *plain-weave-derived float weaves* as the prototype from which diverse float weaves developed is supported by the extent of its distribution, both chronological and geographical, and also by the diversity of its application. The weave has been used to create pattern areas on a background of *plain weave* in the so-called 'Han damasks' (described as *damassé* by Pfister, 1934, p. 40, fig. 7 and note 2) which date from near the beginning of the Christian era, and similarly used, perhaps as early as 2000 B.C., on the north coast of Peru (Bird and Mahler, 1951–52, p. 56). It was later used in Peru in more typical 'damask' fashion (i.e. 'turned,' the two faces of the weave alternating to create pattern and background in reversed positions on the two faces of the fabric). Various uses of it are to be found in fabrics from Taiwan, for example, and from several parts of Indonesia; and in one of its most familiar guises, it distinguishes certain *warp-faced* belt weaves of wide-spread occurrence especially in North and South America.

TYPES OF VARIATION

Other *simple float weave* structures showing similar vestigial evidence of *plain-weave* derivation – that is, having the regular 1/1 interlacing of a *plain weave* replaced at regular intervals by 3/1 interlacing (*plain-weave-derived*) – can be described in terms of their deviation from the basic formula of regular *alternating float weave*. The full range of the possibilities of such deviation has probably never been charted, but within the limitations of direct *plain-weave* derivation there are two major types of structural variation, namely variation of *float span* and variation of *float orientation*. Although both may occur in the same structure, they will be illustrated separately in order that the concomitant effects of each may be more clearly differentiated.

NOTE: that inasmuch as the weave structures used here to illustrate these variations were found in fragmentary archaeological specimens and since positive differential identification of the warp and weft of such specimens is seldom possible, it should be borne in mind that specific identification in the following pages of warp and weft direction and of orders of warp- and weft-interlacing apply only to the structures illustrated. No opinion or conjecture about either original or customary orientation of the weave structure is intended. At the same time it should be noted that the value of ethnographic and historic examples of the same (or similar) structures as evidence of the warp and weft orientation of their archaeological forebears is nullified by their variety. Instead, such examples may reflect differences of weaving customs and development.

FLOAT SPAN We have seen (pp. 113 f.) that omission of one of the regular interlacings in a *plain weave* produces a 3-span weft float on one face and a warp float of equal span on the other. If two consecutive interlacings are omitted, a float spanning five elements will be created on one face (see fig. 198) and two elements of the opposite set will be left disengaged (i.e. *floating*) on the opposite face (fig. 199). Omission of three will create a 7-span float countered by a series of three floats (see figs. 205, 206, and 209, pp. 118 f.), and so on. (As can be seen in fig. 198, an alternating alignment of floats spanning more than three elements will always entail a 'mixed' order of interlacing.)

Consistent alternation in the alignment of 5-span floats (fig. 198) results in pairs of 3-span floats on the opposite face (fig. 199); but if 5-span floats are aligned in alternate pairs, they will be countered by reciprocal 5-span pairs (figs. 218 and 219, p. 126). As in the basic 3/1 : 1/1 weave, the regular interlacing of the parent *plain weave* is retained in alternate passages of both warp and weft; it is in the intervening passages that the interlacing order is modified. When there is no variation of float orientation (i.e. when all warp floats are on one face and all weft floats on the other), the faces of the fabric are *dissimilar*.

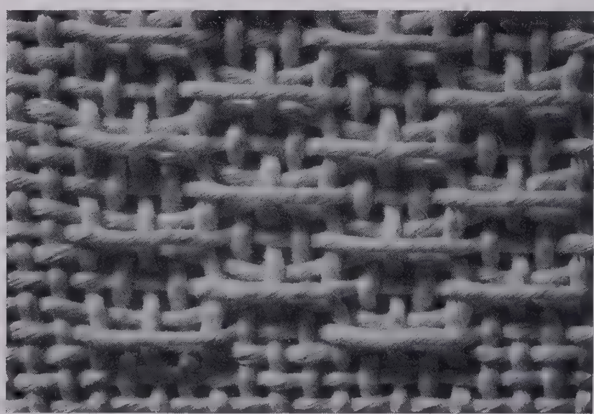


FIG. 198 The *weft-float face* of an *alternating float weave* with 5-span weft floats and a 'mixed' order of interlacing in alternate weft passages. Weft interlacing is 5/1 – 1/1 : 1/1. (See fig. 199.)

NOTE: that a dash (–) between two numerical designations has been used to indicate a 'mixed' or 'combined' order in the interlacing of individual elements, and a colon (:) to distinguish the interlacing orders of successive elements. For example, reference to a sequence of '5/1 – 1/1 : 1/1' interlacing (see fig. 198) indicates that one element has a 'mixed' and the next a uniform order, whereas reference to a sequence of '3/1 : 1/1 : 1/1' (see 'weft-interlacing,' fig. 201) would show that in one passage the element interlaces regularly over-3-under-1 (or under-3-over-1) and in the next two, over-1-under-1.

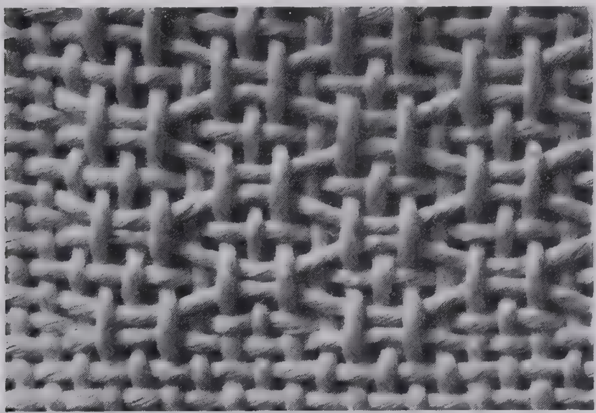


FIG. 199 *Warp-float face* of the float weave in fig. 198, the 3-span warp floats aligned in alternate pairs. The order of warp-interlacing is 3/1 : 1/1.

FLOAT ORIENTATION Another float weave of *plain-weave* derivation – based entirely on combinations of 3/1 and 1/1 interlacing – is found in a fragment from the Negeb desert (fig. 217, p. 121). It demonstrates variation of *float orientation* without variation of *float span*. It differs from the regular *alternating float weave* (pp. 114 and 115) chiefly in having floats of both warp and weft oriented alternately to one and then the other face of the fabric, so that the two faces are structurally *identical*, and warp and weft floats are aligned at right angles to each other on both (figs. 200-202). Both the span and the alternate orientation and alignment of floats are the same in warp and weft but the interlacing orders differ. When woven as shown in figure 201, float-interlacing replaces each alternate *plain-weave* interlacing in the *warp*, but the float-interlacing order itself is *mixed* (3/1 – 1/1). In the weft, on the other hand, the float-interlacing order is *uniform* (3/1) but replaces only every third *plain-weave* interlacing. Figure 202 shows the same structure woven with the interlacing orders of warp and weft interchanged so that it is in alternate *wefts* that the order is *mixed* and in every third *warp* that the *uniform* float-interlacing occurs.

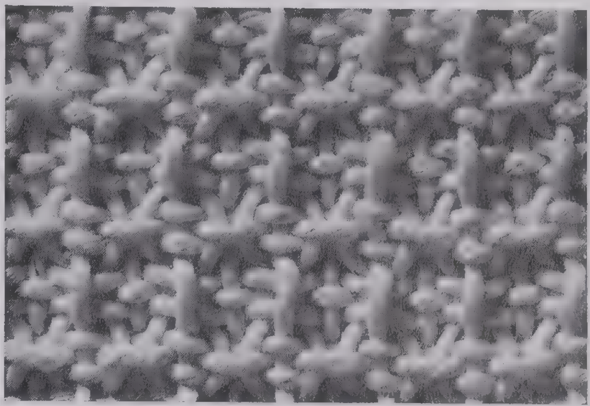


FIG. 200 A *float-orientation* variation of *3/1 : 1/1 alternating float weave* with warp and weft floats in *rectangular alignment* with each other on both faces.

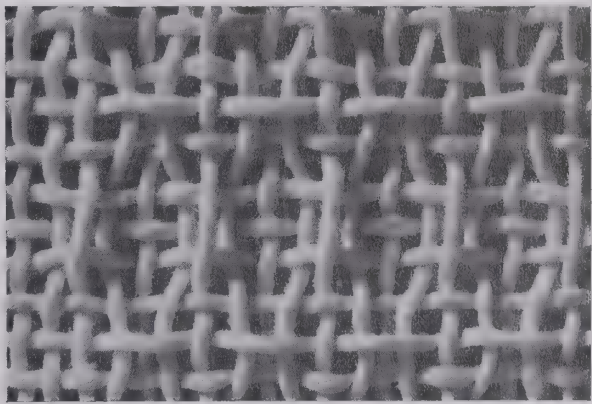


FIG. 201 Diagrammatic construction showing the transition from *plain weave* to an area of the *float-weave* variation shown in fig. 200. (Warp-interlacing, 3/1 – 1/1 : 1/1; weft-interlacing, 3/1 : 1/1 : 1/1.)

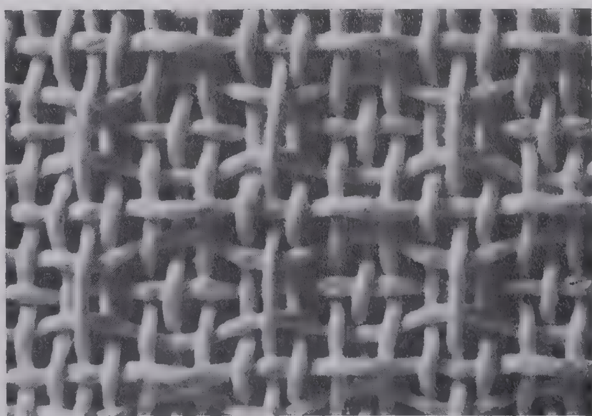


FIG. 202 Diagrammatic construction showing the same structure as that in fig. 201 woven with warp- and weft-interlacing orders interchanged.

VARIANT USES

All these derived *float weaves* with differentiated *warp-float* and *weft-float faces* lend themselves to a damask-like use of the contrast between the two faces that is comparable to the use of *uneven twill* for *twill damask* (see p. 101) and *satin weave* for *satin damask* (p. 112). But the effectiveness of patterning produced by areas of *float weave* set in an otherwise *plain-woven* structure depends on the contrast not between the dissimilar faces of a single weave but between dissimilar weaves.

One simple form of float patterning is effected by a systematic dispersal of small detached groups of floats in areas of *plain weave* (e.g. figs. 203 and 204), often described as 'spot' patterning, the weave sometimes referred to as 'spot weave.' Such patterning is characteristic of some of the diverse weave structures referred to as 'huck' or 'huckaback' (see pp. 124 ff.).

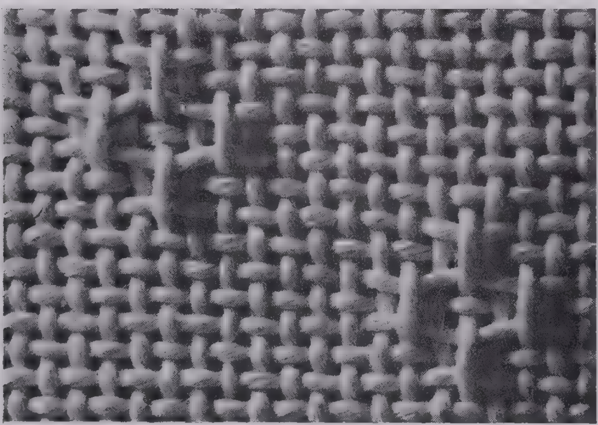


FIG. 203 'Spot' type of patterning effected by dispersing small groups of 3-span warp floats in *plain weave, warp-float face.*

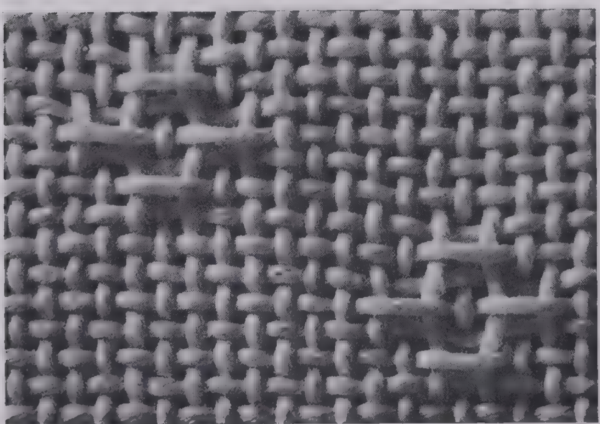


FIG. 204 Opposite *(weft-float)* face, of fig. 203 – groups of 3-span weft floats dispersed in *plain weave.*

The size, distribution, and alignment of small groups of floats (or areas of *float weave*) can be varied, as can the arrangement, span, and orientation of the floats in each group or area.

The tendency of warp or weft floats to draw together the disengaged elements of the opposite set is quite evident in many simple *float-weave* structures. That floats in alternate alignment may thus deflect certain elements of the opposite set so that they appear to follow zigzag courses can be seen in the illustrations on page 114 and in figure 199, page 117. Another effect – in part at least – of this drawing-in action can be seen in figures 205 and 206. Blocks composed of small groups of reciprocal floats (three 9-span warp floats on one face countered by four 7-span weft floats on the other) are shown in both figures, alternately aligned at *a* and vertically at *b*.

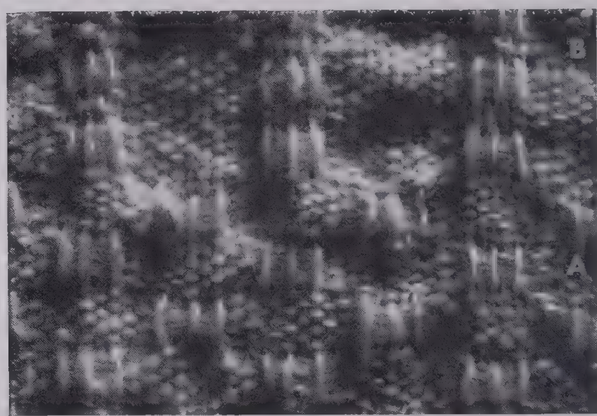


FIG. 205 Groups of three 9-span *warp floats* used for texture patterning on *plain weave*: a) alternately aligned groups; b) vertically aligned. (Wool, single yarns, approximately 8 warps, 15 wefts per cm.)

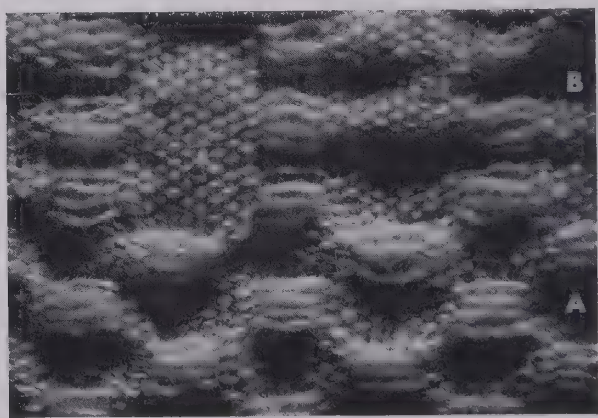


FIG. 206 Opposite face of fig. 205, showing reciprocal groups of four 7-span *weft floats.*

NOTE: that in contrast to the identical ribs formed on both faces of *warp-* or *weft-faced* fabrics by *floats* of the predominant element, the effect of vertical 'ribbing' at *b* in figures 205 and 206 is produced by the contrast between alternate areas of *float-* and *plain-weave*. On one face, the rib-like stripes are formed by vertically aligned groups of warp floats, and on the other, by the reciprocal groups of weft floats. This is not a 'rib weave' but a 'patterning' of one weave with rib-like stripes of another. (Terms like *Bayadère* and *Pékin* are sometimes used to connote, respectively, transverse and longitudinal stripes formed by different weave structures.)

OPENWORK The grouping propensity of floats is also a factor in many of the openwork effects that can be produced in simple *interlaced weaves* without recourse to the crossing and re-crossing of warp elements essential to *gauze weaving* (pp. 180 ff.). For example, figure 207 shows the hint of openwork that will appear in the float weave diagrammed in figure 201 (p. 117) if the alignment of weft floats is shifted so that the three-element groups encompassed by the 3-span floats of the opposite set never vary. Both weaves have structurally *identical* faces.

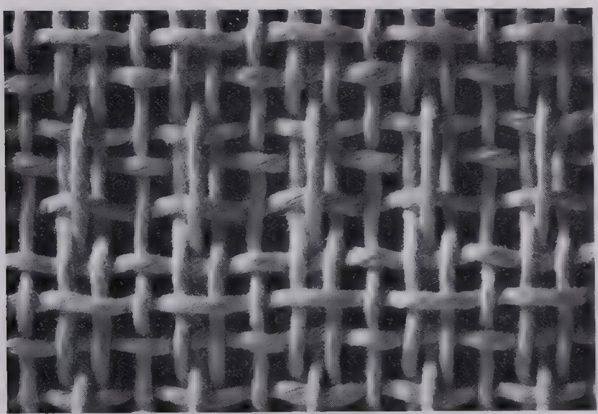


FIG. 207 Diagrammatic construction of a *plain-weave-derived float weave* with warp and weft floats correlated to give a suggestion of 'openwork.' The weft-interlacing order is the same as in fig. 201; the warp order is 3/3 : 1/1 : 1/1 : 1/1.

Perhaps the simplest application of the principle of creating open spaces by allowing the same group of elements to be repeatedly embraced, and thereby grouped, by floats of the opposite set is diagrammed in figure 208. This particular combination of 3/3 and 1/1 interlacing is the one most commonly cited as an example of what is known as 'mock leno' or 'imitation gauze' (for discussion of the use of these terms, see pp. 124 ff.). The order of interlacing is the same in warp and weft (3/3 : 1/1 : 1/1) and the two faces of the fabric are *identical*.

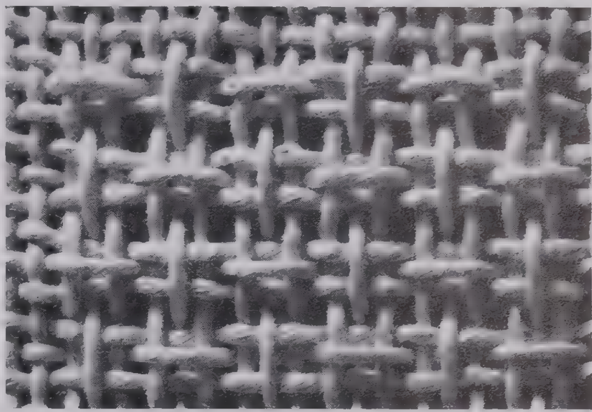


FIG. 208 The particular combination of 3/3 and 1/1 interlacing usually cited as an example of 'mock leno' or 'imitation gauze.' (The two faces are *identical*.)

But the faces of openwork-weave structures are not necessarily *identical*. Figure 209, for example, shows the *warp-float face* of a simple float weave in which both warp and weft interlace 7/1 — 1/1 : 1/1, with the warp floats on one face, the weft floats on the other. In hand-weaving terminology this weave may be referred to as 'lace weave' or, in America, as 'lace Bronson.' (For use of these terms, see p. 127.)

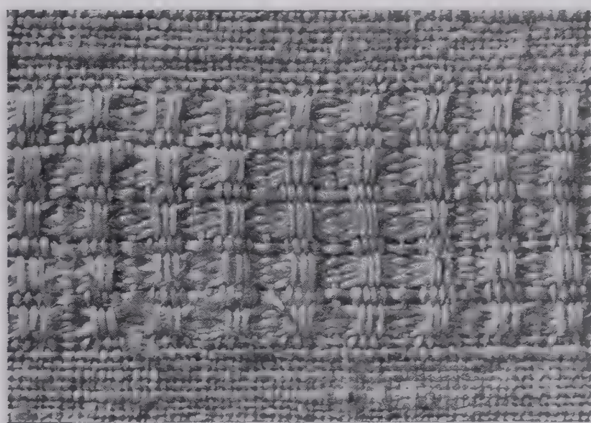


FIG. 209 The *warp-float face* of a simple float weave in which *plain-weave* (1/1) interlacing is combined with 7/1. (The two faces are *dissimilar*.)

Although variations of spacing and tension are often employed to enhance whatever openwork tendency may be inherent in a weave, in many of the weaves called 'lace weave' or 'mock leno' such variations alone produce the openwork quality. Clearly, it should not be assumed that these terms designate specific weave structures.

EXTENDED PATTERNING A different kind of *float-weave* patterning on *plain weave* is produced when the areas of float weave are extended and their shaping elaborated. They can be shaped to create geometrical or figural patterns of varying degrees of complexity. (For use of the terms *damask, damassé,* and '*Han damask*' in this connection, see pp. 133 ff.)

The fundamental soundness of combining the basic *alternating float weave* (pp. 114 f.) with *plain weave* and the adaptability of the combination to somewhat freely elaborated patterning are reflected in the relatively early use of the combination in both China and Peru and in the extent and the variety of its later use. The *float weave* is adaptable to diverse figuring as well as to simple diagonals, and its inherent relationship to *plain weave* ensures an extra measure of structural balance between pattern and background areas.

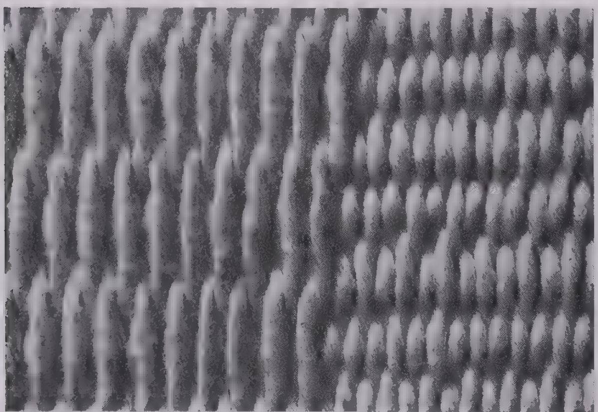


FIG. 210 Textural contrast between the *warp-float face* of *3/1 : 1/1 alternating float weave* and *plain weave* when the fabric is woven *warp faced.* (For diagrammatic construction, see fig. 189, p. 114.)

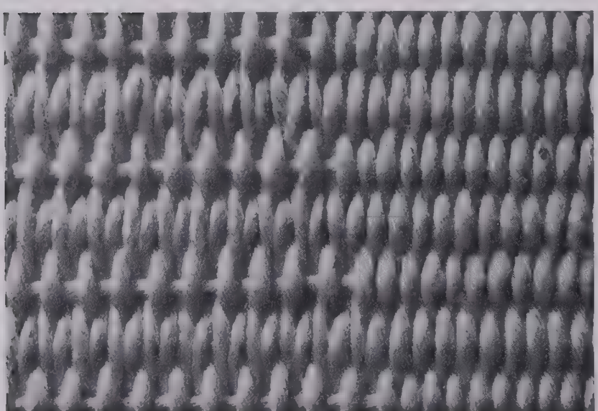


FIG. 211 The *weft-float face* of fig. 210. (For diagrammatic construction, see fig. 190, p. 114.)

NOTE: that when woven as in figures 210 and 211, with one set of elements predominating, the textural contrast between the two weaves is more marked – and any patterning proportionately more effective – on the face to which floats of the predominant element are oriented; but when warp and weft counts are equal – or nearly so, as in figures 212 and 213 – the amount of textural contrast between the areas of *float weave* and those of *plain weave* does not differ noticeably on the two faces.

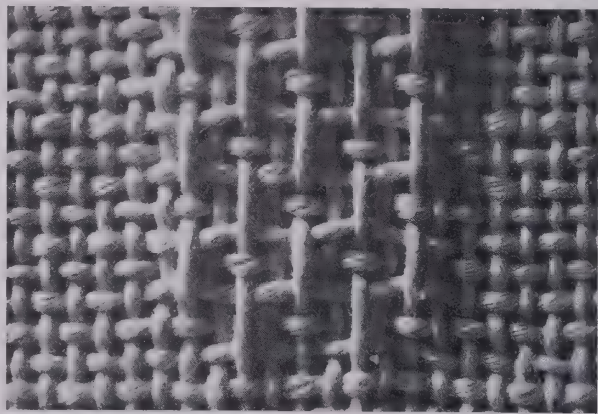


FIG. 212 Textural contrast betwen the *warp-float face* of *3/1 : 1/1 alternating float weave* and *plain weave* when the thread count of the fabric is relatively 'balanced.'

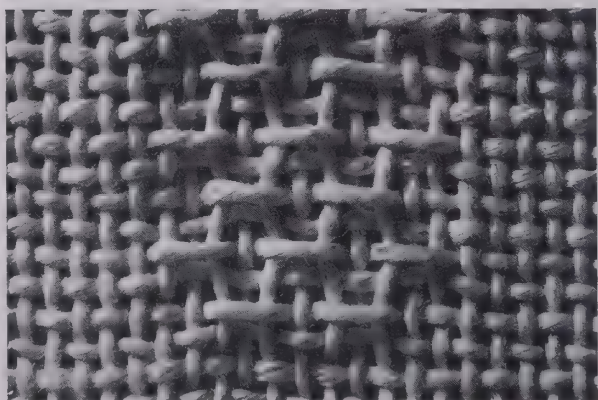


FIG. 213 Opposite face of fig. 212 showing the *weft-float face* of the *float weave.*

NOTE ON SIMILAR EFFECTS IN DIFFERENT WEAVES

The possibility of employing a *twill weave* to produce a fabric patterned by marked verticals or horizontals is apparent in the wales that are formed in either *warp-* or *weft-faced twills* when floats of the predominant set of elements are lengthened by reversals of the diagonals (see figs. 126 and 127, p. 96).

Figure 215 demonstrates that although the appearance of the fabric in figure 214 suggests *plain-weave* derivation, the structure of the fabric is actually based on *2/1 twill* — the twill repeatedly 'turned' and the direction of the diagonals repeatedly reversed. Modification of the *warp-interlacing* order (with periodically lengthened warp floats) in conjunction with a constant numerical order of *weft-interlacing* is typical of *horizontal herringbone* (see pp. 94 and 102); and the tendency of the fabric to 'cord' or 'flute' when first one aspect of the weave and then the other is oriented to the same face of the fabric in narrow bands is characteristic of *uneven twill* (see p. 101).

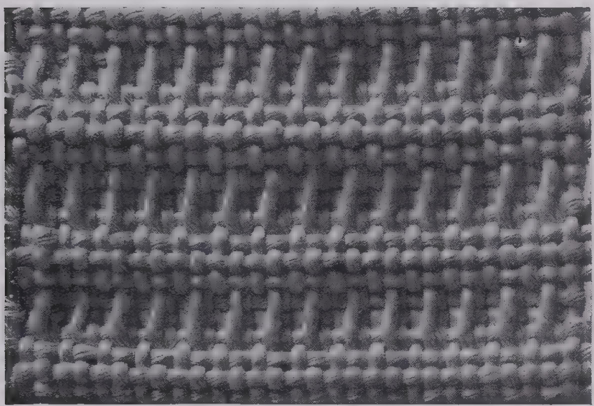


FIG. 214 A *float weave* based on *2/1 twill*. The opposite face is structurally *identical* except that the warp-float areas are in reversed positions.

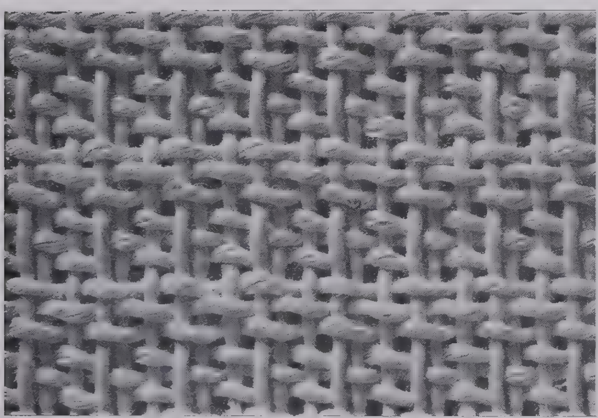


FIG. 215 Diagrammatic construction showing how the *float weave* in fig. 214 was produced by alternately 'turning' the weave (interchanging the faces) and reversing the diagonals of a *2/1 twill* structure.

NOTE: that when the lengthened warp floats are oriented first to one face and then the other (fig. 214), the two faces of the fabric are *identical*; whereas if the twill had not been 'turned,' the lengthened warp floats would have been conjoined on one face, with the weft floats falling in regular *horizontal herringbone* order on the other, and the faces would have been *dissimilar*.

There are many other comparable correlations with *twill weaves* to be found in the structures of ribbed and 'corded' fabrics, among them those with *weft floats* in longitudinal alignment which relate to *vertical* instead of *horizontal herringbone*. An example of the similarity of effect produced by float weaves of different derivations can be seen below. The structure of the 'corded' area of the fabric in figure 216, for example, is that diagrammed in figure 215; the structure of the fabric in figure 217 is diagrammed in figure 201 on page 117.

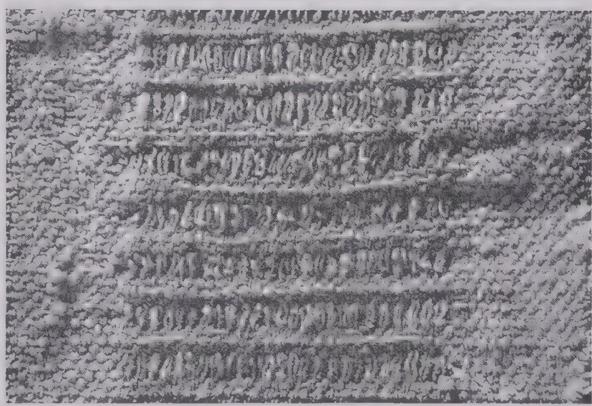


FIG. 216 Detail of a 2-color cotton fragment from the north coast of Peru in which a vertical area of the *float weave* (based on *2/1 twill)* diagrammed in fig. 215 lies between two areas of *plain weave* (the warps in both areas are paired). Collection of Junius Bird.

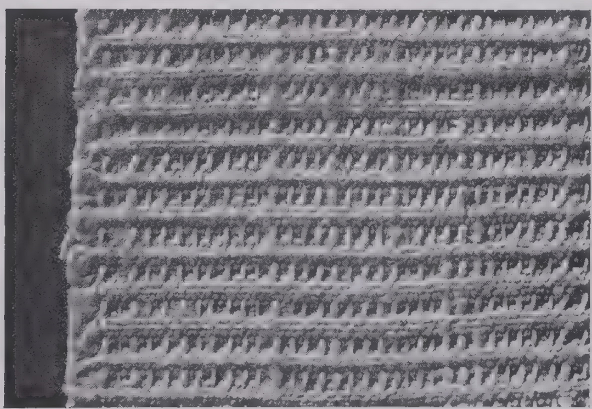


FIG. 217 Detail of a cotton fragment (T.M. 12.4) from Auja el-Hafir in the Negeb desert in Palestine (ca. A.D. 670) in the variation of *3/1 : 1/1 float weave* diagrammed in figure 201 on p. 117.

Notes on the Use of Terms

Float · Skip · Overshot · Flushing

The term *float* as applied to textiles seems to be defined with something approaching unanimity. It is used as both noun and verb and there are some minor differences of emphasis and limitation; but there is general agreement that the term refers to a free passage or 'skip' of one weaving element over (or under) two or more of the opposite set (see p. 75). The term *float* is sometimes defined as if it were applicable only to weft elements, but there seems to be no equivalent way of referring to the same structure in the warp and, according to the majority of definitions and most usage, the term can be applied with equal validity to either warp or weft, with the exact application designated, when required, by addition of the appropriate term (viz. *warp-float*, *weft-float*). When, as in some definitions, the term *float* is said to refer to the passage of an element of one set 'over' certain elements of the opposite set, presumably 'on either face of the fabric' is implied. When, in other definitions, the passage is described as 'over or under,' and whenever the term *underfloat* is used as the converse of *float*, a single view of the fabric structure is implied, as well as identification of the 'right side' of the fabric. (In a few instances – perhaps all stemming from a single published definition – the term *float* is applied only to threads left loose on the back of patterned fabrics between pattern areas.)

Qualifying statements about the particular purpose – or the possible inadvertence – of a float structure enter into some definitions of the term. For example, in certain usage (chiefly industrial) a *float* is an error – an unintentional 'skip' or 'free passage' of one element over two or more of the opposite set, or, more precisely stated, over elements 'with which it should be interlaced according to the weave.' In other words, the term *float* sometimes means a float that is longer than it should be. We have noted (pp. 113 f.) that a float results when one of the regular interlacings of *plain weave* is omitted, whether or not by intention. In the concept of a *float* as a 'flaw in the weaving' the idea is both extended, so that the term denotes an omission of any regular interlacing, and limited by the qualification that the omission be an error. Thus floats that are 'errors' are distinguished from the regular floats of a *float weave* by the fact that they break the regular order of the weave. The term *skip*, although sometimes defined as entirely synonymous with *float*, often serves specifically as an equivalent for *float* when *float* refers to a flaw in the weaving. Used in this way, it offers a way of distinguishing one meaning of *float* from the other.

The chief qualification involving positive intent is included in certain definitions of the term *float* in expressions like "for the purpose of forming certain designs" (Linton, 1954, p. 288; Harmuth, 1915, p. 67; et al.), "in order to build up the pattern motif" (Steward, 1946-59, Vol. 5, p. 777), "in order to build up a pattern" (Start, 1948, p. 107), and so on. But references to the use of floats for patterning, whether to qualify definitions of the term *float* or in discussions of *float weaves*, tend to mislead by implying that floats are used only for pattern building, when they are, in fact, almost equally important as a means of producing and varying textural qualities.

Another term, *overshot*, is more apt to suggest patterning but is sometimes defined simply as a synonym for *float* and/or *skip*, and, like them, can refer to unintended floats (or flaws). It also, on occasion, refers explicitly to weft floats, to weft floats as used for patterning, and again to floats of special 'pattern-wefts' which are *supplementary* to the wefts of a ground weave (as on p. 142). It is the word *shot* that gives the term *overshot* its specific 'weft' connotation – since one passage of a weft is commonly referred to as a 'shoot' or 'shot' of weft (as well as a 'pick') – and terms like *overshot weave* and *overshot pattern weave* usually refer to weaves characterized by *supplementary* weft-float patterning (see also p. 173). In view of the strong association of the term *overshot* with weft floats and weft-float patterning, its use as an alternative for *float* or *skip* seems unnecessarily ambiguous.

Still another term, *flush* (or *flushing*), is more generally used than either *skip* or *overshot* as an exact equivalent for *float* – *flush*, when *float* is used as a verb; *flushing*, when it is used as a noun; and either *flush*, *flushed*, or *flushing*, when *float* is used as an adjective. Often, the term is defined only by reference to *float*, as, for example, 'the same as *float*,' 'see *float*,' and so on. When defined in more detail the

variations of meaning ascribed to it usually parallel those of *float*. When *flushing* is differentiated from *float* it will usually be found that *float* is being used as a generic term and *flush*, or *flushing*, to denote one particular application of the use of it. *Flushing* is sometimes associated exclusively with *twill* and used either to refer to weft floats in twill weaves or to designate twills characterized by weft floats (i.e. *uneven twills* in which the *weft-float face* is intended, or presumed, to be the 'right side'). At other times, however, *flushing* is used for special reference to *warp floats*; and 'flushing weaves' are described as those in which *supplementary* or auxiliary 'flushing warps' are used to add either texture or pattern to a ground weave. In fact, specific association of the term *flushing* with *warp floats* seems to be considered valid only when the 'flushing' elements are *supplementary* ones added to the warp and weft of the ground weave. Both in general use, and in particular association with either warp or weft floats, the term seems to be more British than American (in America its chief use seems to be in connection with power-loom weaving). But it appears that, even in England, *flushing* was better known and more widely used as a textile term in the 19th century than at present, when the trend seems to be toward the use of the term *float* and of its equivalents in other languages.

NOTE: that *flushing* is also the name of a woolen cloth variously described as being rough, thick, coarse, and/or made of 'shoddy,' a material presumably named for its place of manufacture, the port city of Flushing (*Vlissingen*) in Holland.

The terms *float weave* and *float-pattern weave* are sometimes used interchangeably but it is more practical to distinguish between them by using *float weave* as a generic term for *simple weaves* in which elements pass regularly over or under more than one unit of the opposite set, and *float-pattern weave* for those in which pattern is produced by floats of extra warp and/or weft in addition to a ground weave. A *plain weave* can be patterned by areas of *float weave*; but if patterned by floats of extra warp or weft, the weave would be a *float-pattern weave* with the *plain weave* forming the ground.

Pattern-weave · Figure-weave · Fancy weave

There are many statements to the effect that all *float weaves* – in fact all weaves that deviate from the basic alternation of *plain weave* – can be classified as *pattern-* or *figure-weaves*. The term *fancy weave*, too, is often used in the same way, that is, as a blanket classification, negative in nature, for all *simple weaves* not specifically classified as *plain weaves*. The same terms sometimes include (or are used solely to describe) the weaves of color-patterned fabrics with or without the specific qualification that they be weaves in which patterning is effected by means of *supplementary sets* of warp and/or weft (see pp. 140 ff.).

Used simply as counter-terms for *plain weave* none of the three terms has any particular value and all of them tend to be misleading. For example, it seems quite unsuitable to refer to *satin weaves* as *pattern-* or *figure-weaves* when one of the chief merits of *satin weave* is its smooth-surfaced lack of any noticeable effect of patterning. The same thing is true of most *broken twills* and often of *alternating float weaves* which are no more 'patterned' or 'figured' in themselves than *plain weave*, although like *satin* and *plain weave* their unpatterned surfaces can be used as contrast to other weaves or aspects of weaves in creating 'pattern areas' (see p. 134).

The word *fancy* certainly has no specific structural significance and might better be used descriptively either as an equivalent for 'ornamented' or 'elaborated' or for general reference to variation from normal or standard forms. The amount of elaboration or the nature of the variation suggested by the word *fancy* (whether in the term *fancy weave*, *fancy cloth*, *fancy twill*, or *fancy satin*, qq.v.) will depend largely on the individual.

On the other hand, the terms *pattern-weave* and *figure-weave* could both be made more definitive if certain limits to their application and some differentiation between them were generally accepted. At present the term *pattern-* (or *patterned-*) *weave* is in more common use than *figure-* (or *figured-*) *weave*, and there seems to be a slight but rather practical tendency to use *figured* to suggest a larger, freer, and generally more elaborate patterning, and *patterned* for the smaller, simpler, usually geometric sort (see FIGURED TWILLS, p. 106). To a large extent, however, the two terms are used interchangeably whether in reference to color-patterned fabrics or to weaves, *compound* or *simple*. When they refer to *simple weaves*, they refer without differentiation to either of two relationships between weave structure and structural patterning. In one, the relation-

ship is intrinsic. It is the structure of the weave, determined by the length (span), order, and alignment of series of floats, which creates the pattern; and the basic weave structure itself must be varied if the pattern is to be varied. Patterning of this sort which can be described as 'weave-patterning' is characteristic of many of the *twill weaves* (*plain, herringbone, diamond,* and so on) although not of *broken twill*. In the other application of the term *pattern* to *simple weaves,* the inherent relationship between pattern and weave is secondary, and the term refers to a superimposed patterning which is essentially one of areas – areas delineated by the contrast between 'patterns' in the other sense, that is, those inherent in one weave or another. Such 'area-patterning' is an outstanding characteristic of *damask* weaving and of all weaves patterned by contrast either between different weaves or between opposite aspects of the same weave (see pp. 132 ff.). To be more specific: most *twill weaves* are 'pattern weaves' in the first sense (i.e. the order of interlacing is such that certain configurations of diagonals are produced) while any of the *twill weaves* can be 'pattern weaves' in the second sense, if they are used to differentiate between pattern- and background-areas.

NOTE: that this distinction between types of structural patterning is reflected in the foregoing classification in which a variation of the patterning inherent in a weave is classified as a *variation* of the weave structure (e.g. *vertical herringbone* is a *variation* of *twill weave* and might be said to be 'weave patterned') whereas 'area-patterning' by means of contrasted textures is classified as a *variant use* of the weave structures involved (e.g. *twill damask* represents one *variant use* of *twill*, viz. 'turning,' and is 'area-' as well as 'weave-patterned'). Note also that a *variation* of a given weave structure may be employed in a *variant use* of the structure as, for example, when the twill in a *twill damask* is a *herringbone twill*. (Any pattern inherent in the weave or weaves of an area-patterned fabric should be identified, as well as the fact that the fabric is area-patterned.)

The problem then is to find, and agree upon, either different terms that will distinguish between these two ways of creating pattern, or different ways of using the word *pattern* that will indicate which is referred to. For example, if it were agreed that the term *pattern-* (or *patterned-*) *weave* should refer only to the first kind of patterning and *figure-* (or *figured-*) *weave* only to the second, *damask* would be a *figure-weave* which might be made up of *pattern-weaves*. Or, if it were agreed that 'weave-pattern' would refer to pattern inherent in a weave structure and 'area-pattern' to pattern shaped by the boundaries between contrasting weave textures, *damask* would be an 'area-patterned' weave in which the areas of pattern and background might or might not be 'weave-patterned.' In general the latter terminology seems more descriptive and, if it were to be generally employed, the terms *pattern* and *figure* could be used to distinguish degrees of elaboration.

Fancy cloth · Huckaback · 'Bronson' · Mock leno

The import of the word *fancy* in the term *fancy cloth* is as indefinite as in other fabric terms in which it is used (e.g. *fancy weave*, p. 123, and *fancy twill*, p. 129). *Fancy cloth* is a particularly general term whose rather vague meaning is stretched, now one way, now another, according to the dictates of convenience. It is commonly but not exclusively associated with weaves in which there are no *supplementary warps* or *wefts*, and some relationship to *plain weave* is often implied (presumably in the word *cloth*, see p. 85); but the term serves chiefly to suggest miscellany, that is, weaves not easily classified. There seems to be a tendency to use it to signify patterning of some sort – sometimes, although infrequently, to signify the breaking and patterning of *plain weave* by *floats*. But attempts to discover the limits which circumscribe its use are thwarted by the generalities with which it is defined, and we are forced to conclude that it can be counted on to do little more than imply some hard-to-classify departure from the regular formula of some *simple weave* – usually *plain weave*.

Among the miscellaneous weaves which at one time or another have been called, or been lumped together under the heading, *fancy cloth*, are those here classified as "float weaves derived from plain weave" (see pp. 113 ff.). Included are assorted weaves variously referred to as *huckaback*, or *huck, canvas weaves, spot weaves, mock leno, imitation gauze, lace weaves, Bronson, lace Bronson,* and so on. Sometimes practically all weaves designated by these terms are grouped under one presumably general term like *huck* or *Bronson* while the other terms are

used to differentiate weaves whose orders of interlacing may be identical but whose appearance and texture are altered by spacing, tension, and yarn characteristics. In other instances, the weaves are not treated as one related group. Instead, one or several may be differentiated in somewhat less well-defined ways; and it is not unusual to find the same actual weave structure used to illustrate one of these terms in one part of a treatise and another in another.

Examination of various works on textile analysis, design, and manufacture, as well as a number of textile dictionaries, representing both British and American usage (and to a more limited extent German and Spanish), indicates that closely related *plain-weave-derived float weaves* are likely to be found in two different categories. The significance and range of both the categories and the terms used for them differ; but there are usually weaves in one category identified as *huckaback*, and in a different category, weaves designated *mock leno, imitation gauze*, or by some similar term.

The terms *mock leno, imitation gauze* (and also *lace weave*) are sometimes used in such a way as to include weave structures more commonly known as *huck* or *canvas weaves*; but being terms that are clearly meant to imply an effect of openwork, they refer, not to specific weave structures or types of structure, but to such weave structures as may be used to create openwork and only when so used (see p. 119). Used for effects other than openwork the same structure is usually given a different name.

The origin of the term *huckaback* (commonly shortened to *huck*) has been discussed at length many times; and it is generally agreed that the term for the weave derives in one way or another from the linen towelling at one time peddled by travelling 'hucksters' in the British Isles. The weave is frequently described as a 'linen weave'— not in the sense of the German *Leinwandbindung*, meaning *plain weave* (see p. 85), but as a weave especially appropriate for linen towels because of the extra absorbency imparted to the fabric by the floats that are characteristic of the weave. Of course, the expression 'linen weave' is sometimes used in still another sense, that is, to designate any weave associated particularly with the weaving of linen thread; but originally (probably in the late 17th century), the reference of the term *huck* was to towelling and to a considerable extent it remains so today. In nontechnical usage in particular, the 'linen' connotation seems to have diminished as the use of cotton for towelling has increased. The association with towelling, however, remains; and it might be rather more informative if *huck* were described as a 'towel weave' rather than as a 'linen weave.' It is in fact only with the 'towel' requirements of a fabric in mind that it becomes possible to understand why certain weaves happen to be fairly consistently classified as *huck* while other very similar ones are usually classified as *mock leno* or *imitation gauze*. I have been unable to find any statement of comparison or differentiation, and often enough the same weave structure is referred to by either term impartially; but a careful study of the terms or headings under which various specific weave structures are described and illustrated discloses a fairly consistent though unstated (and not necessarily tenable) basis for classifying such closely related weave structures in separate categories.

Questions inevitably arise when such a differential classification is put to use without adequate explanation of the basis for it. In this case confusion seems to result from the fact that while there is every appearance that the terms are used and defined as terms for 'weaves,' analysis of the way they are applied reveals that it is not primarily to certain weave structures that they refer, but to certain weave structures in so far as they produce certain fabric qualities. So it is in the 'towelling' associations of the term *huckaback* (and of equivalents like the Spanish *gusanillo* and the German *Gerstenkornbindung*), and in the 'openwork' implications of the terms *mock leno, imitation gauze, semi-gasa, falsa gasa, Scheindreherbindung*, and so on, that we find a key to the nature of the two categories and a possible basis for distinguishing between them.

We can safely assume, I believe, that firmness as well as absorbency would be required of a fabric to be used for towelling; and in general, it seems that the firmer the weave (i.e. the larger and more numerous the areas of *plain weave*) the more likely the structure is to be classed as a form of *huck*. Conversely, the more the disposition of *float-* and *plain-weave* interlacing is such as to effect openings in a structure, the more apt the structure is to be called *imitation gauze* or *mock leno*. Of *huck* it has been said that "at least half the structure consists of plain weave" and that "the cloth consists of alternating areas of slack and compact weaves" (Read, 1931, p. 60); and the same could be said of the weaves

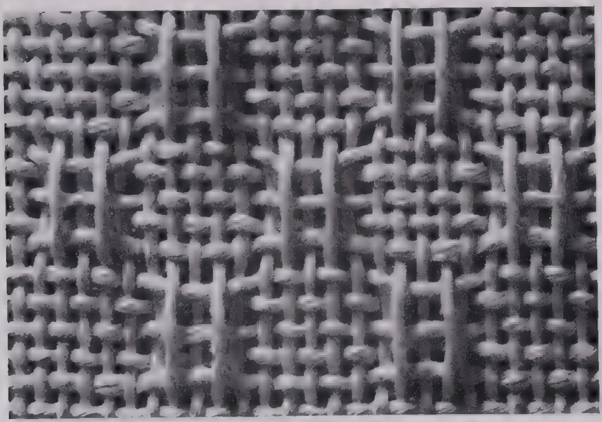


FIG. 218 The *warp-float face* of a combination of 5-span floats and plain-weave interlacing typical of the weaves called *huck* or *huckaback*. Interlacing order in both warp and weft 5/1 – 1/1 – 1/1 : 1/1.

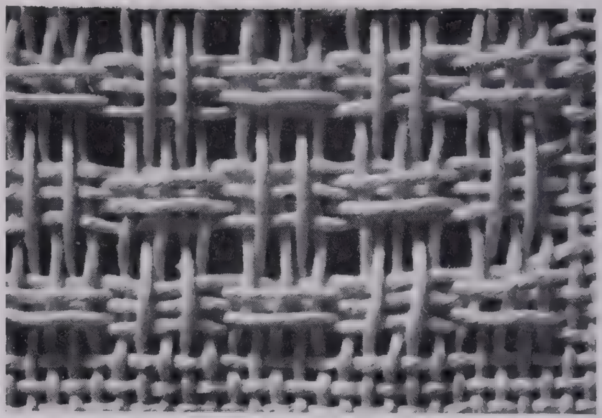


FIG. 219 A combination of 5-span floats with plain-weave interlacing typical of the weaves called *mock leno* or *imitation gauze*. Interlacing order in both warp and weft 5/5 : 1/1 : 1/1 (the faces are structurally identical).

called *mock leno* and *imitation gauze*, if the reference to 'areas' were omitted. However, mention is seldom made of either the presence or the significance of *plain-weave* interlacing in 'mock leno' or 'imitation gauze' weaves, although it is the contrast between the firmness of the *plain-weave* interlacing and the relative slackness of floated elements that is largely (and often wholly) responsible for any effect of 'openwork.' Perhaps it is only because the *plain-weave* interlacing is not so arranged as to produce actual 'areas' of *plain weave* that it is not mentioned. In any event the most commonly noted difference between the weaves employed for their 'towelling' characteristics and those employed for their 'openwork' effects can be stated in terms of the presence or absence not of *plain-weave* interlacing but of 'areas' of *plain weave*. Figures 218 and 219 illustrate the distinction. Although each structure is made up of 5-span floats in combination with *plain-weave* (1/1) interlacing, the differences in arrangement result in quite different fabric qualities.

The use of the term *Bronson weave* is peculiar to 20th century American hand-weaving. There is no question about how it came to be used but a great deal of uncertainty about how it is or should be applied (if at all). Bronson is the name of the authors of an early 19th century American treatise on domestic weaving and dyeing (Bronson, J. and R., 1817). The name was injected into the terminology of American hand-weaving more than one hundred years later by Mary M. Atwater in a way which she later (Atwater, 1941) explained: "In this . . . work I came upon several drafts for linen weaving written in a manner I had not seen elsewhere. [It should be noted that, according to the title page, the "work" relates specifically to the "manufacture of cotton and woolen goods."] No name was given this special weave in the book, and in order to have a handle for it I gave it the name of 'Bronson weave'." She goes on: "The weave, as I learned later, is more correctly known as 'spot' weave, and appears to be of English origin." She mentions that "in an ancient English weaving book . . . it was given not only for linens but also for the making of shawls" and adds that "In Colonial America, however, it appears to have been used rather exclusively for linens." She identifies the "weave" as a "form of threading," at the same time remarking that in many uses the "forms are so distinct as to be actually separate weaves" (*ibid.*, p. 9). In the succeeding description of some specific uses, the types of Bronson weave are classified as "(1) a weave for fine linen; (2) an openwork lace-weave . . .; (3) a weft-effect . . . weave [which proves to be one in which a supplementary pattern weft is used]; (4) a warp-faced patterned rep . . ." (*ibid.*, p. 12) and Mrs. Atwater explains that "these weaves are classified together simply by reason of the manner in which the fabrics are constructed and the drafts are written" (*ibid.*, p. 17).

NOTE: that I have included this detail because it is almost never possible to know so exactly how a term came to be employed or to be told by the individual who first used it something of what it was meant to convey. The example illustrates some typical vagaries of limited classification and also throws light on some of the peculi-

arities of hand-weaving usage (notably the tendency to define and classify in terms of the 'set-up' or 'threading') which should always be taken into consideration when hand-weaving terms are used to describe fabric structures whose actual method of construction can only be postulated.

Ever since the term *Bronson weave* was coined, it has been widely used but never with much precision. It has been used as roughly equivalent to *huck*, when *huck* is defined as a weave for linens; and also for weaves identified by the 'peculiarity of threading' as described by Mrs. Atwater, that is, having alternate warps "on one harness" and "the remaining harnesses . . . used for the pattern" (*ibid.*, p. 9). Presumably such a weave is called *lace Bronson* if arranged so as to produce openwork (see p. 119); and the term *Bronson* has come to be used at times, again like *huck*, as a general term covering an assortment of *plain-weave-derived float weaves*. However, if *Bronson* is to be of any use as a technical term it must be more carefully defined and a definite basis for its application stated and adhered to.

The terms *spot weave* and *spot patterning* seem almost self-explanatory, although just what constitutes a 'spot,' and whether or not anything should be assumed about the weave structure which produces it, is seldom clear. Nor is it clear whether anything about the nature of the ground weave is to be inferred from the term as usually used, or whether or not the 'spots' are, or can be, produced by *supplementary* elements. It would seem that in any but a highly specialized terminology the term *spot* can only serve for general description of a kind of patterning.

In the weaves called *honeycomb* we again find simple combinations of plain- and float-interlacing orders. But these are distinguished from similar structures by the cell-like declivities they produce in the texture. Although it is seldom apparent in the fabric, 'honeycomb' weaves are often basically *diamond-weave* structures.

Canvas weave is a term used more to describe than to define a fabric structure, although it is also employed on occasion both as a general term covering a variety of weaves and as a definitive term for one or another specific weave structure.

Lace weave, too, is often used as a broadly descriptive term – for any openwork produced in the process of weaving – and also as a general technical term for certain types of weave structure that tend to produce openwork. Again, one particular weave structure may be singled out by one individual to be designated *lace weave*, and another by another.

NOTE: that *gauze weave* is occasionally included in the very ill-defined category of 'lace weaves,' although usually separately classified as a 'cross' or 'crossed-warp' weave (see pp. 181 ff.).

At present none of these terms can contribute much to precise identification or designation of weaves. At best, one or another of them may serve metaphorically to suggest to certain readers some familiar weave structures with which to relate those under discussion. Obviously, however, the weaves thus suggested to the reader may not be the ones intended by the writer.

TERMINOLOGY OF TWILL WEAVES

The terminology of *twill weaves* is so extensive and the qualified uses of the term *twill* so extremely diverse that it would be impossible even to list within the space of these notes the different meanings attributed to the most common twill terms. Aside from original usage (which may never be determined) most 'twill' terms have been used and re-used in different circumstances to designate various distinctions of structure, pattern, or fabric quality. As a result, there are almost none that can now be used definitively even in limited fields of special fabric study. In selecting terms for the major classificatory divisions of *twill weaves* as presented in the preceding pages, first consideration was given to making use of any widely-recognized association between a given term and a structural type (e.g. *diamond twill*). When two or more terms seemed relatively equal in the extent of their association with the same structural type, or when application of a single term seemed fairly evenly divided between several different designations, other considerations affected the selection.

Descriptive aptness, for example, has been considered a primary asset; and it is also felt that the use of related terms for related structures usually more than makes up in clarity and precision for any awkwardness of expression or lack of brevity it may entail (e.g. *horizontal* and *vertical herringbone*). The ambiguity caused by an almost equally common

use of one term in two quite different senses has sometimes been avoided by choosing substitutes from among the alternative terms for each meaning (for example, substituting *horizontal herringbone* for one use of 'reversed twill,' p. 94, and *turned twill* or 'counterchanged twill' for another, p. 101).

Even · Equal · Balanced · Regular

Uneven · Unequal · Irregular

The *twill weaves* constitute such a large and diverse group that any general discussion of them usually involves some kind of over-all classification which first divides the structures, on the basis of the ratios of over-and-under interlacing, into *even* and *uneven* or *equal* and *unequal twills.* The two sets of terms usually serve to differentiate the same two basic types of twill interlacing — the one in which the interlacing is *over* and *under* the same number of elements (e.g. 2/2, 3/3) and the one in which elements pass *over* a larger or smaller number than they pass *under* (e.g. 3/1, 3/2, 4/2). There seems to be a tendency, however, to explain the distinction between *equal* and *unequal* in terms of 'relative amounts of warp and weft on the surface.' This is rather more suggestive of equality or inequality of warp and weft 'count' than of equality or inequality of warp and weft interlacing orders, and it leads to a kind of misinterpretation to which the terms *even* and *uneven* are less subject. The terms *even-sided* and *uneven-sided* are good descriptive equivalents of *even* and *uneven* but to a considerable extent seem to have been discarded in favor of the briefer form. It appears that when the term *even-sided* (or 'even-sided effect') is found in current use it is more likely to be in contradistinction not to *uneven-sided* but to some term such as 'warp effect' or 'filling effect' which specifies one or the other face (presumably the known or postulated 'right side') of an *uneven twill.* The terms *regular* and *irregular* are only occasionally used for the distinction between *even* and *uneven* ratios. They are more likely to serve for reference to specific series of interlacing orders than for over-all classification of twill types.

Balanced is another term used to designate *even* (or *equal*) *twill*, but it is like *equal* in suggesting relative 'thread counts' and is more commonly used for that purpose. (Use of its opposite, 'unbalanced,' seems to be avoided in either case.) Although literally descriptive of *uneven twill*, the term *two-faced* is rarely used. It suggests *compound-weave* structures (q.v.) and is probably better reserved for specific application to them. Occcasional use of the term *reversible* as an equivalent for *uneven* is puzzling, but presumably is based on the all-too-common use of *reversible* to denote characteristics 'in reverse' (see NOTE, p. 133). The term may be intended to refer to the fact that the ratio between warp and weft on one face of *uneven twill* is the reverse of that on the other. However, the fact that the direction of the diagonals on both faces of both *even* and *uneven twills* is literally 'reversed' (i.e. opposite) makes the general concept of reversal, no matter how expressed or intended, a poor basis on which to differentiate one from the other. Finally, and curiously, at one time or another *even* and *uneven twills* have each been distinguished from the other by the term *fancy*, with *fancy* used to describe whichever one is uncharacteristic of the particular group of fabrics under discussion.

There are, of course, many names for specific twills: *2/2 twill* may be known as 'serge' or 'double jean,' for example; *2/1*, as 'fustian twill' or 'blanket twill.' Such names are really fabric names which by association imply structure, rather than terms for fabric structures, and they are, in general, as unreliable as they are numerous.

NOTE: that twill structures are not always classified as *even* and *uneven* (or in some equivalent manner). It is not unusual to find *twill*, like *satin*, conceived and defined as a 'single tie' weave (2/1, 3/1, 4/1, etc.), and not only all *even* twills but also such *uneven* twills as 3/2 or 4/2 classified as *variations* of *twill weave*.

Simple · Plain · Regular

Compound · Combined · Irregular · Broken · Fancy

On the basis of schemes of warp- and weft-interlacing, *twills* are variously classified as *simple* and *fancy*, *simple* apparently meaning plain, unvaried, or 'ordinary,' that is, having continuous diagonals (see pp. 92, 93, and 94); as *simple* and *compound*, *simple* meaning constructed with single sets of warp and weft elements (see p. 75); or as *simple* and *combined*, *simple* referring to a single, unmixed order

of interlacing. Or they may be classified as *plain* and *fancy*; *regular* and *irregular*; *regular, broken*, and *fancy*; and so on (v.i. for further description of the term *fancy twill*).

The most common use of the term *plain twill* is to designate twill in which the order of interlacing is unmixed and unvaried and the diagonals continuous, that is to say, the weaves that represent the simplest exemplification of the basic principles of twill interlacing. The term *regular* is sometimes used in exactly the same way. *Biased* and *diagonal* refer particularly to the continuous-diagonal trait, although both serve at times as synonyms for *plain*; but in other usage, *diagonal* is reserved for special reference to so-called 'large' or 'steep' twills. The term *irregular*, although occasionally used as a general classificatory term for all twills not classified as *plain* (i.e. *regular*), seems to be used chiefly in reference to *twill patterning* (to indicate unequal distances between reversals of diagonals, for example, or an irregular arrangement of them) rather than to designate structural characteristics. Since there is no type of twill structure to which the term *irregular* applies in the same sense that it does to the irregular distribution of binding points in *irregular satin weave* (see p. 111), the term *irregular twill* tends to remain conveniently non-specific and its use variable and somewhat idiosyncratic.

The terms *broken* and *fancy* are used not only as synonymous generic terms for all *twills* not classifiable as *plain*, but also to differentiate between two groups of non-plain twills. Since each term has a number of more specific uses as well, each will be discussed separately.

BROKEN TWILL In its generic use (as a synonym for *fancy*, for example), the term *broken* refers to any twill in which the diagonal lines are not continuous; that is, if the diagonals change direction they (and the *twill*) are said to be *broken*. In a somewhat more specific use, the diagonals and the twill are said to be *broken* only when there is a break in the continuity as well as a change in the direction of the diagonals, that is, when the diagonals are *staggered* along the lines where they change from one direction to the other (e.g. figs. 123, 124, p. 95) instead of meeting at a common point (e.g. figs. 122, 125, p. 95). In a still more specific use, the diagonals and the twill are called *broken* only when the diagonals are so 'broken up' as to eliminate any effect of diagonal patterning, that is, when the direction is changed and the continuity broken at such frequent intervals (every third shed) that no diagonal alignment is established (figs. 124, p. 95, and 155, p. 103). Although this is probably the most definitive current use of the term (often made even more explicit by the expanded expression 'broken, or satin, twill' or by defining *broken twill* as 'imitation satin'), in earlier usage (19th century) *broken twill* often referred to what is now almost universally known as *satin weave*, in which the continuity of the diagonals is completely broken up by regular intermissions.

The tendency seems to have been to draw the line between *broken twill* and *satin* at the point where it first becomes possible to make the diagonal consistently intermittent and relatively invisible (i.e. in a 5-shed weave) and to call a 4-shed *twill*, in which the diagonals are as nearly intermittent as possible, a *broken twill* (less often, *satin twill, satinet*, or *imitation satin*, see p. 138). In the less common but obviously reasonable practice of classifying *satin* as a form of *twill, broken twill* will be found referred to as 'four-thread satin,' '*satino de cuatro*,' '*satin de 4*,' and so on. (For further discussion, see p. 131.)

FANCY TWILL There are certain terms in any vocabulary which could be called 'catch-all' terms; and in the vocabulary of *twills* and *twill weaves* the term *fancy twill* is an outstanding example. It seems to have appealed to many writers as a conveniently generalized term under which to group a great variety of twill weaves. Unlike *broken*, which has other more definitive uses, *fancy* serves almost entirely as a generic term, although not a very clear or useful one (see p. 123). As was noted above, it is used in some classifications as the converse of *plain* – in which case *plain twill* may refer solely to twills having no breaks in the continuity or direction of the diagonals; it appears in others as the converse of *simple*, when *simple* implies diagonals of uniform width. According to the latter usage *fancy twill* refers specifically to a combination of two or more different simple twills, and the term *fancy* is equivalent to *combined*. Another limited use will occasionally be noted in which *fancy* serves as the converse of 'standard' or 'ordinary.' Its meaning will then differ according to what is considered the normal twill structure of the group of fabrics under discussion. Thus we may find a regular *2/2 twill* included in the twills termed *fancy* simply because *2/1 twill* was

more commonplace either in a particular group of fabrics or in the author's experience.

We find the term *fancy twill* variously used and defined as the equivalent of 'irregular,' 'patterned,' or 'combined' *twill* (in the sense indicated on p. 106); also as the equivalent of 'diaper,' of 'twill damask,' or as a general term meant to imply some or all of these *variations* and *variant uses* of twill. Although the term *fancy twill* is sometimes used as the equivalent of *broken twill,* it is also used, conversely, to differentiate the 'combined-twill' types of twill variation from twills having 'broken' or reversed diagonals. It is often used as a general term not only for all variations of structural patterning in twill, whether by reversal of the face of the weave (e.g. *diaper, twill damask,* etc.) or by changes in the direction of the diagonal (see *herringbone, diamond,* etc., pp. 94 ff.), but even at times for pattern combinations of *twill* and *plain weave.*

Clearly the term *fancy twill* has little positive or definitive value. It is, in fact, usually defined in terms of what it is not. *The Century Dictionary* (*and Cyclopaedia*) of 1889-99 effectively summarizes what perhaps continues to be the general concept of *fancy twill* when it describes the "parallel lines or ribs" formed "over the whole face of *twill* cloth," adding, "but the regularity of the parallel lines is broken in various ways in what is termed *fanciful twilling*" (vol. 8, 1899, p. 6552).

Reversed twill · Herringbone · Wave · Zigzag · Chevron

Many classifications of *twill weaves* and many terminologies make no distinction between the structural patterning produced by reversals of direction of twill diagonals along horizontal (or transverse) lines and that produced when the changes of direction are aligned vertically. (Some, particularly classifications for the use of industrial designers, make no mention at all of the former.)

However, the distinction is frequently made by using different terms – for example, *reversed twill* or *wave* for >>>, and *herringbone* for ΛΛΛ; although there are those who identify ΛΛΛ as *wave.* More often the same term is used for both types (usually with a list of presumably synonymous terms like *herringbone, chevron, wave, zigzag,* even 'broken'). The distinction is then made in terms of 1) the direction of the 'zigzag'; 2) the direction of the *axis,* 'line of change,' or 'break line'; or 3) the loom set-up and the weaving process. In terms of loom set-up and weaving process, reversal 'by means of draft' or 'in the threading' is distinguished from reversal by means of 'treadling plan' or 'in the treadling.' It is in this last sense that the term *reversed twill* is probably most widely used, that is, to designate a *twill* in which the direction of the diagonals is reversed as the weaving progresses (see p. 94).

Many different terms are used to differentiate between the two possible directions of the *zigzags* formed by successive changes in the direction of twill diagonals – differentiating between, for example, *vertical* and *horizontal, warp-wise* and *weft-wise, lengthwise* and *lateral, longitudinal* and *transverse.* The same terms are used again to differentiate between the two possible directions of the *axes,* 'lines of change,' or 'break lines,' along which the diagonals change direction; but when so used the structure described is the opposite of that described when the same term refers to the direction of the *zigzags.* For example, when the reversal of diagonals is described as being 'in the treadling' or 'by means of the treadling plan' (see *horizontal herringbone,* pp. 94 f.), the *zigzags* could be described as *vertical, warp-wise, lengthwise,* and so on; but the *axes,* 'lines of change,' or 'break lines' of the same twill would be *horizontal* (i.e. *weft-wise, lateral,* or *transverse*).

It would seem logical, if a *twill* is referred to as *zigzag twill,* to make the differentiation on the basis of the direction of the *zigzag*; and the same logic would apply to the use of the term *wave,* or *waved,* to the extent that it is free of directional connotation. But to many there seems to be a natural suggestion of horizontal zigzag in the term *wave,* while to others *wave* suggests a curved rather than an angular pattern regardless of direction. However, there is no question of the angularity implied by the term *zigzag*; there is no suggestion of one direction rather than the other; and since it does not suggest symmetry as *chevron* (and to a lesser degree, *herringbone*) does, it is probably most useful when utilized, as suggested on page 97, to specify a twill with uneven intervals between changes of direction.

The term *herringbone* obviously refers to a type of pattern which resembles the spine of a fish with rows of parallel small bones diverging on opposite diagonals. In twill patterning, the 'spine' is in effect the line of change, and it seems logical to refer to

a twill that reverses as the weaving progresses (so that the 'spines' of the herringbone patterning lie across the fabric) as *horizontal herringbone* (e.g. fig. 122, p. 95), and its converse (with vertical or warp-wise orientation of the 'spines') as *vertical herringbone* (e.g. fig. 125).

The term *chevron*, on the other hand, although rather widely used in English (and apparently unchallenged in French) as a synonym for *herringbone*, implies, to the literal-minded at least, an inverted V (Λ), and therefore seems more applicable to horizontal zigzags than to vertical ones. Inasmuch as the term *herringbone* is so much more consistently used in English than any other single term, it seems best to continue to make use of it either as the unqualified designation of patterning in which the line of change (the spine of the herringbone) is vertical, or, preferably, as a descriptive term for the general structural pattern type – to be further distinguished as 'vertical' or 'horizontal.' The fact that the zigzags of a *vertical herringbone* run horizontally emphasizes the importance of settling, if possible, on one kind of designation.

It is often assumed that the term *herringbone* in itself connotes not only the *vertical* type but the vertical type when marked by a *symmetrical* and *exact* meeting of diagonals. On the other hand, the latter characteristic is often specifically expressed by describing the herringbone as 'pointed.' Whereas some contend that all *herringbone twills* should be called 'broken' twills, others reserve the term *broken* for those herringbone twills in which the meeting of the diagonals is *staggered* (or 'inexact') and contrast 'broken' with 'pointed.' It seems clear that unless or until a specific connotation (such as that suggested on pages 95 and 103) can be agreed upon, the exact significance of *broken twill* should be clearly stated whenever the term is used. The word *broken* itself seems more suggestive of intermittence than of regularly repeated reversals of direction; and, in addition, its use as a term with which to differentiate the diagonals of *satin* from those of *twill* is one of long standing. Consequently, it is suggested that the term *broken twill* may best be utilized to designate the 'broken up' types that constitute a kind of transition form between *twill* weaves and *satin*.

Although it seems obvious that the conformation of the 'spine' of the herringbone can vary in the same ways in *horizontal* as in *vertical herringbone twills*, the distinction between the two types of conformation is seldom noted unless the herringbone is vertical. There is, for example, no *horizontal-herringbone* equivalent for the term *dornik* which is frequently used to connote a specific weave structure, namely, a *vertical herringbone* with the reversals of the diagonals *staggered*, in contradistinction to 'pointed' *herringbone* in which the reversals are *symmetrical* and exact. (*Dornik* may also refer to a simple form of *diaper weave* when *diaper*, v.i., implies patterning by 'turning' or 'counterchanging' a *twill weave*.) The terms for distinguishing types of *diamond twill* according to the nature of the reversals of the diagonals are discussed in the following paragraphs.

Diamond · Lozenge · Birdseye · Goose-eye · Crystal · Diaper

When in a *twill weave* there is a co-ordinated reversal of diagonals in both directions, diamond (or lozenge) shapes are formed, and the *twill* is referred to (with remarkable unanimity) as *diamond twill*. True, there are other terms in use. *Lozenge* seems to serve as a less commonplace equivalent for *diamond* with no differentiating connotation implied by its use. *Birdseye* (and, less commonly, *goose-eye*, *pheasant-eye*, et al.) is sometimes used generically for any *diamond twill*; sometimes, more specifically, to connote so-called 'pointed diamonds' (i.e. those with exact, *symmetrical* meetings of the diagonals); and sometimes with the additional connotation of small diamonds and all-over patterning. *Diaper*, in one of a number of diverse senses, is used simply as another synonym for *birdseye twill* (other uses are discussed on p. 136).

All of the foregoing terms imply – and all are usually used to designate – figures having four equal sides and four angles, of which the opposite ones at least are equal. When used in reference to *twill weaves*, it is assumed that the terms refer to twills in which the diagonals meet each other exactly along both axes. But, as noted and illustrated on page 98, if the diagonals of such a twill, instead of meeting at a point, are displaced – or staggered – along either or both axes, a true diamond shape is not formed, and the central 'eyes' that characterize 'birdseye' *diamond twills* are lacking. One term – in rather limited use – specifically designates the non-pointed (asymmetrical, or staggered) *diamond twill*, namely, *crystal twill*. Margrethe Hald illustrates (1950, p. 147, figs. 132 and 133) the distinction which

she makes between a "pointed diamond or goose-eye twill" and a "non-pointed diamond or *crystal twill*" (my italics). The term *crystal* as originally used may have been descriptive – suggesting comparison between a crystalline structure and the faceted appearance given to a diamond-like twill patterning by the displacement (or staggering) of the diagonals. However, probably because of the lack of a comparable term for the non-pointed herringbone twills of which a 'crystal twill' is composed, there are already signs of a tendency to disregard the descriptive quality and extend the use of the term *crystal* to refer to *non-pointed herringbone* as well as to *non-pointed diamond twill*; that is, to make it synonymous with *non-pointed* rather than with *non-pointed diamond.*

Reversed · 'Turned' · 'Counterchanged' · Damask

The term *reversed* is sadly overworked, particularly in relation to twills. We know that there are two possible directions that twill diagonals can take – up to the right and up to the left. Therefore, when the direction is changed it can be said to be 'reversed.' We know, too, that the two faces of an *uneven twill* are different; on one side is the *warp-float face*, on the other, the *weft-float face*. Therefore, if the two faces are counterchanged, the weave itself can be said to be 'reversed.' This has led to an unusual amount of confusion in terminology, particularly since the reversals of the diagonals can be along either axis of the structure. Thus the term *reversed twill* could refer to a twill in which the diagonals change direction at intervals either across or along the fabric (or for that matter, in both directions); or it could refer with equal validity to one in which the two faces of the weave structure are repeatedly interchanged. There seems good reason, therefore, to avoid using either *reverse* or *reversed* as terms meant to designate a type of twill structure. A *twill* can be described as having 'reversed diagonals,' but the term used to designate the weave should be a term that not only specifically denotes reversed diagonals but distinguishes the direction of the reversals (e.g. *vertical* or *horizontal herringbone*). Similarly, a twill fabric can be described as having the weave 'reversed' but the weave itself should be designated by a term which specifies that it is the faces of the weave structure, not the diagonals, that are reversed (e.g. 'turned' or 'counterchanged').

NOTE: that in addition to the meanings commonly ascribed to the term *reversed* (or *reverse*) *twill* there are various less often used – perhaps quite individually assigned – meanings such as: "twill weaves with the warp thread predominating on the face" (Harmuth, 1915, p. 132) which probably is meant to refer to weaves in which the *warp-float face* is considered the 'right side'; "twill which has reverse in direction but is not necessarily symmetrical" (Tidball, 1953, n.p.) which seems to refer to what has been called *zigzag twill* (see p. 97); and "the same as Double Twill, i.e., double cloth woven in twill" (Zielinski, 1959, p. 125). But although this last meaning is annotated "In U.S.A.," I have been unable to find evidence to justify it.

Perhaps the best known and most widely recognized exemplification of patterning by means of reversals of a weave structure – that is, of using one aspect of the weave for pattern areas and the other aspect for background, thereby creating a fabric that is *reversible* (in the literal sense) and also characterized by *reciprocal reversals* (v.i.) of the weave – is 'satin damask.' *Satin-weave damask* is, in fact, such a familiar fabric type that analogous uses of weaves other than *satin* are often referred to as *damask* (as in *twill damask*, for example) and have been referred to here as 'damask-like uses' of other weaves (e.g. *twill*, or an *alternating float weave*). Nevertheless, it should be noted that the term *damask* is so unalterably associated in many people's minds with the elaborate patterning and lustrous appearance of typical *satin-weave damasks* in silk or fine linen that association of the term *damask* with other fabric qualities and materials is often felt to be infelicitous if not actually misleading. (For further discussion of *damask* and related terms, see pp. 133 ff.)

Thus, although terms like *twill damask* may be widely enough accepted to be reasonably definitive as terms of structure, the connotation of elaborate patterning and fine material is strongly entrenched, and terms which refer more specifically to the way the weave is used are often preferred when neither the quality of the resulting fabric nor its patterning is typical of *damask*. The most common of these terms, if we disregard the misleading 'reversed,' is undoubtedly *turned*. Used to qualify the name of a *simple weave*, 'turned' describes the fact that the weave structure is literally 'turned over' and used

now one face up, now the other. (To 'turn' a weave is to use the structure with the other face up.) *Counterchanged* is a more specific term for the same thing. It is less commonly used and more cumbersome, but is at the same time more precise than *turned*.

NOTE: that inasmuch as no explanation has been found for use of the term *interlocking* as an equivalent for *counterchanging* (in reference to *twill weaves*) further use should probably be avoided.

Reversed · 'Reversible' · Reciprocal reversal

By their nature, *simple weaves* with *even* orders of interlacing produce fabrics with *identical* structures on the two faces and with color equivalence as well. If the interlacing is *uneven*, the structural *dissimilarity* between faces may be accompanied by a corresponding variation in 'color effect'; and if an *uneven weave* is reversed in the sense of being 'turned'— to produce pattern — the pattern areas will be exactly duplicated on the two faces while the structures and their related 'color effects' will be *reversed* in the sense of being 'in reverse' (e.g. figs. 185 and 186, p. 112). This reciprocating characteristic of *simple weaves* is exemplified (and exploited) in *damask weaves* and in the analogous adaptive uses of weaves having *dissimilar* faces (see below).

In *compound weaves* (pp. 140 ff.) *reciprocal reversal* of color in association with duplication of both weave structure and pattern areas is characteristic of many *double-faced* weaves and is found both in true *double-cloth* (pp. 156 ff.) and in various *double-faced* types of *warp-* and *weft-float patterning*. In addition there are examples of *reciprocal reversal* of color in which the pattern areas are duplicated but not the weave structure (e.g. figs. 260-263, p. 154).

For some reason (presumably the awkwardness of more appropriate alternatives) the term *reversible* has been widely but loosely used in fabric descriptions to designate, instead of literal reversibility, a *reciprocal reversal* of color, with or without a correlated reversal of weave structure. Of course, it is often used quite literally and grammatically to describe the fact that a fabric 'admits of being reversed,' that is, that the two faces are equally usable, that there is no 'wrong side,' that both sides are, for practical purposes, 'right sides.' So used, the term relates more to the nature and use of the finished fabric than to its structure and usually implies nothing at all about pattern. It designates the same characteristics wherever found (in fabrics of widely varying degrees of structural elaboration both with and without patterning) and is quite as applicable to *tapestry-woven* fabrics which have *identical* structures and color areas on the two faces as to *two-faced* fabrics whose structurally *dissimilar* faces may be dissimilar, too, in color and pattern — or may be entirely unpatterned. Inasmuch as *reversible*, in its literal sense, is an unambiguous term which is in common use, it seems impractical to impair its usefulness by borrowing it to convey certain arbitrarily assigned ideas. Although the two characteristics — *reversibility* of the fabric and *reciprocal reversal* of structure and/or color — are often found in the same fabrics, there is no intercausal relationship between them and the same term should not be used for both.

NOTE: that when the term *reversible* is used in reference not to a fabric but to a weave structure, it may be intended to mean literally that both sides of the structure can be used and hence that the faces of the weave can be *counterchanged*; and this may explain occasional use of the designation 'reversible twill' apparently simply to mean that the two faces of the twill are different — that is, that the *twill* is *uneven*.

Damask · Twill damask · Damassé · 'Han damask'

There seems to be no difference of opinion about the origin of the word *damask*. The fabrics originally so-called undoubtedly took their name from the ancient city of Damascus in Syria. However, in defining the term *damask* it is often stated that the fabric (or weave) derives its name from the city 'where it was first made'; and that statement is not easily substantiated. We know that by the twelfth century at least Damascus had become famous for its trade in exquisite and expensive silks (Gay, 1887, p. 538); and it is reasonable to assume that fabrics which might now be described as *damask* were among those on which that fame rested. But confirmation of the statement that the *damask weave* was first made in Damascus would require agreement on the exact nature of *damask weave* as well as more exact and detailed knowledge than seems to be available about the varieties of early fabrics actually produced there, and

whether or not any particular one was referred to as 'damask.' (Apparently the first application of the term *damask* to 'linen damask' was in the 16th century.)

However, any reference to what "might now be described as *damask*" is at best indefinite and may be misleading, inasmuch as each individual's notion of 'damask' is made up of a number of components, any one or more of which may differ considerably from those constituting another person's concept. First, it should be noted that unquestionably as originally used, and even now according to nontechnical concepts and definitions, the word *damask* refers to a kind of fabric rather than to a weave structure – presumably to a fine fabric of silk or linen, usually in a single color, more or less elaborately patterned, and 'reversible' (v.s.). In addition, the variety of connotations of the term *damask weave* (i.e. of *damask* as a technical rather than a fabric term) reflects varying ideas of the technical nature of the fabric. Nevertheless, several of the component ideas (over and above the fact that the term itself can be traced to the name of the ancient city of Damascus) have been found to be common to a large proportion of more than seventy-five varied but largely technical definitions of the term *damask*; so that, on the basis of both general usage and specific definition, we seem to be justified in assuming that the statement that the term *damask weave* implies patterning would not be challenged. There also seems to be almost complete agreement that it is essentially a *simple weave* (having a single set each of warp and weft elements). This means that the most common concept of *damask* as a technique is of a weave in which both pattern and ground are formed by the same two basic sets of elements, warp and weft. This concept is frequently further delimited by the idea that the two sets are always identical in color, if not in fiber and quality as well. Thus we have, as a start toward an agreement on the nature of *damask*, a concept of a *monochrome patterned simple weave*. In addition, *damask* is quite consistently said to be 'reversible.' By this is usually meant, not just that the fabric is literally reversible (which it almost always is) but that there is a *reciprocal reversal* of weave faces in relation to pattern areas on the two sides of the fabric (see p. 133).

Now if it is agreed that *damask patterning* is (or at least can be) produced without benefit of either color variation or *supplementary sets* of warp or weft, it must be further agreed that such patterning is structural. However, in *damask* it is necessary to distinguish between two kinds of structural patterning (see pp. 123 f.). One ('weave-patterning') is inherent in the weaves or aspects of weaves whose juxtaposition creates the areas of contrasted texture that constitute the other ('area-patterning'); and it is 'area-patterning' that is the distinguishing characteristic of *damask weave* and the kind of patterning usually meant when it is said that *damask* is 'structurally' or 'technically' patterned.

When it comes to the technical nature of the area-patterning in *damask*, opinions differ and definitions vary. According to the most precise interpretation, *damask* is patterned by the contrast between the *warp-float* and *weft-float faces* of a *satin weave*. According to a slightly less rigid but rather more common interpretation, the patterning can be effected by contrast between the two faces of *uneven twill* as well as *satin*. If one considers the indistinct line of demarcation between *broken uneven twill* and *satin weave* (see p. 129), it is not difficult to understand why this extension of meaning seems eminently practical to many. What is more, the logic of again extending the interpretation to include use of contrasting aspects of any *simple* weave having *dissimilar* faces is hard to deny.

But *damask* is sometimes described in somewhat less precise phrasing as being patterned 'by variations of weave structure,' and on that basis, unless definite limitations of application are stated, it is held that any fabric patterned by the contrast between any two weave structures is properly termed *damask*. (In practice, it is customary to specify at least one of the two weave structures employed – as, for example, 'a ground of plain weave patterned by a different tie' or 'a satin ground with a design of different weave' – and sometimes to qualify the term *damask* with the prefix *pseudo-*.)

On the principle that a fabric patterned by 'variations of weave structures' can properly be called *damask*, some of the early figured silks of China have been given the name of 'Han damasks'; but the term *Han damask* is itself differently applied on different occasions. Apparently it was first used for fabrics in which a basically *plain weave* was patterned by areas of alternately aligned 3-span floats (i.e. simple *alternating float weave*, p. 114) and it continues to be associated with this particular combination of weaves. (The combination has also been

described as 'plain weave damask' and, apparently, as 'warp rep damask' when it is woven warp-faced.) At the same time a basically *plain-woven* fabric patterned by 3-span floats in *diagonal* alignment is called now a 'Han damask,' now a 'twill damask,' now described as 'employing the twill tie in the patterned areas of monochrome damask weaves,' and occasionally even identified simply as a 'twill weave.' Yet any one of these simple-weave fabrics patterned by areas of 3-span floats on a *plain-weave* ground may prove to be what, under certain circumstances, is meant by the term *fancy cloth.*

In order to differentiate the monochrome *simple* fabrics in which a pattern is produced by weave structure that is unlike that of the ground from those in which the design is produced by the opposite face of the ground weave, the term *damassé* is sometimes borrowed from the French. It is used in English instead of its English equivalent (which, literally, would be 'damasked') and also in German; a Spanish equivalent is *adamascado*; Italian, *damascato*; and so on. But usage tends to be equivocal. Reference is to fabrics or weaves which are to some extent damask-like although differentiated in one way or another from some particular concept of 'true damask.' Thus, the term *damassé* is employed not only to describe the use of two different weaves (of whatever nature) for damask-like patterning; but also to describe the damask-like use of weaves other than *satin* (often to differentiate 'twill damask' from 'satin damask'). In industrial terminology, *damassé* is sometimes used for 'linen damask,' that is, for a damask-like fabric when composed of a fiber other than silk. However, both the weave distinction and the fiber distinction can be made without ambiguity by simply qualifying the term *damask* with the name of the weave (e.g. *twill damask*) or the name of the fiber (e.g. *linen damask*) – or both. And if, in addition to distinguishing the weave, one wishes to avoid suggesting that a damask-like use of a weave is marked by patterning or fabric qualities typical of *damask,* the particular weave can be described as 'turned' or 'counterchanged.' As a technical term, the greatest usefulness of *damassé* would seem to lie in distinguishing the area-patterning effected by two different weaves from that effected by the two aspects of the same weave.

Double damask is a term primarily associated with table-linen damask, and its connotations reflect the standardization attendant upon commercial development of the fabric type. The term usually connotes an 8-thread *satin* woven in damask fashion in contradistinction to the 5-thread structure of what is known as *single damask.* The latter has also been called *bastard damask* when it was assumed that the term *damask,* if unqualified, would apply only to 8-thread *satin damask.*

Among the terms used as, or said to be, equivalents for *damask weave* are: 'double satin,' 'turned satin,' 'counterchanged satin,' 'fancy satin,' 'interlocking satin,' and 'reversible satin.' But the equivalence is not exact. For example, a *damask weave* may be described as a *turned* or *counterchanged satin weave*, but if the contrast between the faces of the satin weave is used only for simple stripes or bands, the term *damask* may seem inappropriate. In fact, one of several uses of the term *diaper* is to distinguish a 'turned' *satin weave* when it is employed to produce simple geometric patterning, from the same weave when it is used to delineate the complexities of so-called 'damask patterning' (see p. 136). The association of a certain concept of patterning with the term *damask* seems inescapable. Even when *damask* is defined as a generic term for various 'turned' weaves, the weaves themselves are sometimes differentiated as 'damask,' 'diaper,' or 'dice' weaves, according to differences in design characteristics.

In summing up these interrelated terms, it could be said that to describe a fabric as *damask* would suggest a monochrome, more or less elaborately patterned, 'turned-satin' weave of silk or linen (although 'linen damask' is usually so-called); to describe one as *damask weave* would imply that the device of 'turning' or 'counterchanging' a *satin weave* had been used to create somewhat extended and intricate figuring; while the term *damassé* might imply similar patterning but different weave structures. Use of the term *twill damask* would indicate a fabric patterned by 'turning' a *twill weave*, and would tend to imply some complexity in the design; and 'Han damask' would suggest *plain weave* patterned by areas of a simple 3-span-float weave (either diagonal or alternating, but especially the latter). Throughout, it is the concept of 'area-patterning' by means of contrasted weave textures that, more than any other, seems to be implicit in the term *damask* – and to some degree suggested by any term derived from or related to it.

NOTE: that the term *Han damask* is definitely associated with silk weaving of the period of the Han Dynasty in China. It can be useful for comparative descriptions of comparable patterned combinations of *plain* and *float* weaves in whatever materials and wherever found, but it cannot very well be used as a technical designation unless or until its exact technical implications are defined.

Diaper · *Diaper pattern* · *Diaper weave*

In its most common use, the term *diaper* refers to a kind of allover *patterning* distinguished by certain broadly defined characteristics. Although there is some difference of opinion about the origin of the word, there seems to be evidence that *diaper* was once the name of a figured fabric – usually said to have been a rich, all-white or monochrome cloth figured in a distinctive way – and that, subsequently, patterns or systems of ornament like those found in the fabric came to be called *diapered* or known as *diaper patterns*, whether in wood, stone, metal, or any other material. So we now find that *diaper* (pattern) is frequently defined in terms of the fabric from which it presumably derived, and that *diaper* (cloth) is just as frequently defined either as a cloth characterized by a *diaper pattern* or as a weave structure which produces the kind of patterning known as *diaper*.

Diaper patterning is variously described as a 'system of ornament of a continuously flowing type' or, more explicitly, 'small patterns repeated at short intervals,' or 'continuous repetition of small design elements,' or in some similar way. Sometimes 'small flowers' are specifically mentioned; sometimes 'geometric patterns' and 'lattice work'; and sometimes an arrangement in 'diamond-shaped compartments' is noted as being the identifying attribute of *diaper patterning*. In fabrics, *diaper pattern* is often described as 'simple woven allover pattern.'

In textile definitions of *diaper*, we find the idea of a monochrome fabric recurring – in phrases like 'warp and weft of the same color,' 'pattern indicated only by the direction of the thread'; or in statements to the effect that the fabric shows a pattern 'by the direction of warp and weft,' by 'contrasting luster,' or 'by opposite reflections of its surface.' Clearly it is structural patterning that is meant, and the idea that it is patterning by means of contrasting warp- and weft-float faces is strongly suggested. Used in reference to weave structure, there is a tendency to associate the term *diaper* with twill weaving, either when twill diagonals form small diamond patterns such as *birdseye*, or when patterns, particularly squares, are formed by 'turning,' 'reversing,' or 'counterchanging' the faces of an *uneven twill weave*.

The most common single component of the diverse concepts of *diaper* as a *weave* is the use of a 'turned' weave for patterning. As a 'turned-weave' structure, *diaper* is sometimes defined as 'turned-twill patterning' in contradistinction to the 'counterchanged satin' weave to which the term *damask* usually refers. But according to other definitions *diaper* is itself a *satin weave* (geometrically patterned) while a *twill* used in the same way may be referred to as *dornik*. (There is great variety in the use and spelling of, and the origin attributed to, the term *dornik*. For a quite different connotation, see p. 131.) When the term *diaper* refers to a *satin weave* rather than to a *twill*, the reference is usually to a weave that differs from *damask* only in its patterning – which is simple and geometric in contrast to the more elaborate and sometimes figural patterning characteristic of *damask*. On the other hand, the designation *diaper* may be limited quite definitely to alternation of the two faces of a *satin weave* in squares (a weave-pattern combination sometimes described as 'dice weave'); or it may be that the square-pattern but not the *satin-weave* connotation will be retained, and the term *diaper* used to denote alternate squares of the two faces of any weave.

We find then that if, for example, a fabric structurally patterned by squares of the opposite faces of a weave is referred to as *diaper* (or as *diaper weave*), there are a number of possible reasons for the use of the term. It may be that the 'turning' of the weave is the chief reason for calling the fabric *diaper*. Again, it may be because the weave that is 'turned' is a *twill* rather than a *satin weave*, or conversely because it is a *satin* rather than a *twill*. It may be that the fabric is called *diaper* simply because the structural patterning is in the form of squares, or because it exhibits a combination of attributes each of which has some association with the term *diaper*.

Certainly when *diaper* is used as a descriptive term for a type of patterning, it should always refer to the same type regardless of the medium in which the design occurs; and apparently the general concept of the kind of design it describes is relatively undisputed. But as a term with which to designate either a general fabric type or a particular variety

of weave structure, the meaning of *diaper* must be much more firmly and clearly delimited if it is to be of any use. Using the term *diaper weave* will help to avoid any mistaken assumption that the reference is to patterning alone; and another step toward clarification would be taken if the practice of using the term as a synonym for another which is entirely adequate (such as *birdseye*, or *diamond, twill*) were eliminated.

Satin · Sateen · Satinet

The duality of the term *satin* – the fact that it is used with equal validity either to name a fabric having certain characteristic qualities or to designate a weave structure which can, but does not necessarily, produce those qualities – has been discussed briefly on page 108. The two meanings are distinct but they are not mutually exclusive, and with whichever import the word is used it is likely to suggest some of the connotations of the other. The term *satin weave*, while clearly referring to the structure rather than the fabric, always seems to imply something of the smoothness and unmarked lustrous surface for the sake of which the structure is so often employed; while at the same time the idea of a particular kind of weave-structure seems to be implicit in the everyday concept of *satin* as a kind of cloth. The term *sateen*, too, is used for both fabric name and structural designation; but in either sense it is usually defined in terms of its relationship to *satin*. Definitions of *sateen* customarily describe the extent and nature of the difference between it and *satin*; and its connotations vary in accordance with the variety of definitions of *satin*.

NOTE: that there is a rather singular usage according to which the term *satin* has no technical significance at all, and *sateen* is used apparently as the equivalent of *satin weave* (Watson, 1954, et al.). Perhaps this is an attempt to distinguish the weave of *satin* from the fabric; but no explanation or justification seems to have been offered for such a decided break with custom, and its acceptance seems to be too limited to be significant.

In contrast to most *simple-weave* structures – even those with *dissimilar* faces – in *satin weaves*, 'right' and 'wrong' sides are not necessarily produced by embellishment or by finishing processes; they may be implicit in the structure of the weave. When, as illustrated on pages 110 and 111 for example, a *satin weave* is constructed with one element predominating numerically, the face on which the floats of that element occur constitutes the 'right side' or the 'face' of the fabric, since it is on that face that the 'satin effect' appears. When it is the warps that predominate, and the *warp-float face* therefore forms the 'right side' of the weave, the *satin* weave (or fabric) is variously described as a 'warp satin,' a 'warp-faced satin,' a 'warp effect satin,' a 'satin with warp-face effect,' a 'satin woven with warp floats,' or (if the fabric is made of cotton or the term *sateen* is being used generically for all *satin weaves*) as 'warp sateen.' At the same time, it is frequently assumed that warp emphasis in the satin structure is categorically implied by the word *satin* without further qualification.

There is even greater variety to be found in designations of the converse of this structure, namely a 'satin effect' produced by floats of a predominant weft (see fig. 176, p. 109). This is the structure usually referred to when the term *sateen* designates a weave, but it is seldom assumed that the term *sateen* alone is adequate to convey the idea. Instead, the 'weft-satin' structure will be described as 'weft satin or sateen,' or as 'sateen (filling-face satin),' and so on. However, those who do not recognize *sateen* as a legitimate designation for weave structure use phrases more comparable to those that describe the analogous warp structures, such as, 'weft satin,' 'reverse satin' (reflecting the idea that *satin* is properly 'warp satin'), 'satin with filling-face effect,' 'filling-face satin,' and – with significant double emphasis –'weft sateen.'

When the term *sateen* is used to convey the fact that a satin-like fabric is made of cotton, it may or may not be intended to convey information about the weave structure. It may be used either to specify that a *satin-weave* fabric is cotton or that the *satin weave* of a cotton fabric is, specifically, a 'weft satin.' On the other hand, there are statements to the effect that 'cotton sateen' can be woven in 'either twill or satin'– in which case a 3/1 'broken' or 'satin' *twill* is probably the twill meant even when not specified.

Application of the term *sateen* is so varied in detail that it is impossible to state or postulate a consensus; but the trend of usage indicates that the term is associated primarily with 'weft-satin weaves,' secondarily with cotton. Nevertheless, there seems to be one recurrent notion which is suggested by the word itself and which underlies practically all the varying concepts, that is, the idea that *sateen*, whether as weave or fabric, is thought of as some-

thing less than *satin* – as a substitute for it. Occasionally the idea is made explicit, and *sateen* is defined as 'imitation satin' (and must surely at some time have been called 'pseudo-satin'). More often, the idea is implicit in the selection of the term, the very use of which indicates either that cotton serves as a substitute for silk in a fabric; or that a weft structure is substituted for the warp structure which is presumably more proper for *satin*; or perhaps that a 'broken' or 'satin twill' is substituted for a true *satin weave*. The term *satinet* (*satinette*) seems to imply the same thing without equivocation. Like *sateen*, *satinet* is sometimes defined as 'imitation satin'; but it is also described as 'an inferior variety of satin containing cotton,' a 'short tied satin' (an expression which suggests *3/1 broken twill*), an 'imitation satin made in 3/1 broken twill,' and so on. The terms *satin twill*, *satinet*, and *imitation satin* have been mentioned as equivalents of *broken twill* (see p. 129). But if *satin twill* and *satinet* are synonymous then the term *satinet twill* is either redundant or is intended to imply an 'inferior' fabric – or perhaps the use of cotton. (It should be noted that presumably *satine* differs from *sateen*, and *satinette* from *satinet*, only in spelling.)

In general, then, we find that the term *satin* is associated with silk (to a lesser extent with linen as well, and in modern textiles, with rayon) and also with use of the *warp-float face* of the *satin* structure; the term *sateen*, with cotton and use of the *weft-float face*. But at the same time we find statements to the effect that *satin weave* is called *satin* when woven in silk, *sateen* when woven in cotton; and according to other statements the 'face' of *satin weave* is usually the *warp-float face*, although it may be the *weft-float face*. Obviously it cannot be assumed that any exact meaning will be conveyed by either term unless further elucidated. But it probably can be assumed that the word *satin* will be interpreted as a fabric name unless otherwise specified. Using the term *satin weave*, however, should make it clear that a structure rather than a fabric is being referred to; the terms *warp-satin weave* and *weft-satin weave* (or perhaps *warp-faced satin weave*) should leave no room for doubt about the orientation of the structure; and other details (e.g. 7/1, *regular*, etc.) can be added. The word *sateen* is probably most useful as a fabric name. As a designation of structure, even the term *sateen weave* is likely to be ambiguous except when specifically contrasted with *satin weave*, as in an expression like 'the satin-sateen structure' sometimes used to describe a *damask weave*.

PART TWO

Classification of the Structures of Fabrics

I Felted Fibers

II Interworked Elements

A. Single Element

B. Two Single Elements

C. One Set of Elements

D. Two or More Sets of Elements

1. Interlacing warps and wefts

a. Simple weaves

b. Compound weaves
(*see below*)

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b. COMPOUND WEAVES

1). Compounded by adding sets of elements

a.) Supplementary sets

(1). Patterning

Extra-weft
Extra-warp

(2). Facing, backing, reinforcement

Floats
Woven-pile

b.) Complementary sets

Double-faced weaves
Two-faced weaves

2). Compounded by combining complete weave structures

a.) Interconnected

Tubular weave
Double-width weave
Double-cloth weave

b.) Integrated

Note on twill interlacing in compound weaves

NOTES ON THE USE OF TERMS

Compound • *Compound weaves* • *Compound weave*

Terms for different sets of warp and weft elements: *Binder-* • *Ground-* • *Main-* • *Pile-* • *Pattern-*

Single-faced • *Two-faced* • *Double-faced*

A variety of terms for one weave structure

Double-faced • *Double weave* • *Double-woven* • *Double-cloth* • *Tubular weave* • *Double-width*

Double-cloth • *Double twill* • *Double satin*

Backed • *Faced*

Overlaid • *Underlaid* • *Laid-in*

Patterning: *Warp-* • *Extra-warp* • *Warp-float*
Weft- • *Extra-weft* • *Weft-float*

Brocade • *Brocaded* • *Brocading* • *Brocatelle*

Pile • *Nap* • *Tufts* • *Tufted*

Terms for pile structures:
Structural • *Non-structural* • *Accessory*
Woven • *'Knotted'* • *Cut-float* • *Needlework* • *Hooked*
Looped-pile • *Cut-pile* • *Pile-on-pile* • *Double-pile*

Names of 'pile fabrics':
Velvet • *Velveteen* • *Plush* • *Terry* • *Fustian* • *Corduroy*

SOURCES OF INFORMATION

B. COMPOUND WEAVES

An over-all classification of the fabric structures that are characterized by the interworking of at least two directionally differentiated sets of elements (transverse, or *weft*, elements interworked with longitudinal, or *warp*, elements) is outlined on page 74, where it is noted that, in addition to being grouped according to the nature of their interworking (i.e. *interlaced* — now under discussion — *crossed, twined, wrapped* or *knotted*), warp-weft structures are classified as *simple* (when composed of only one set each of warp and weft elements) and *compound* (when there is more than one set of either or both and the structure of one face does not necessarily affect the other).

Although it can be argued that *compound-weave* structures should not be called *primary* (and are therefore not properly within the province of this study), there are certain basic ways of adding to or combining *simple-weave* structures to form *compound weaves* which should be noted. A comprehensive enumeration of the manifold types and subtypes of *compound-weave* structures will not be attempted; we shall try simply to distinguish between the basically different ways in which weave structures are *compounded*, noting various functions that can be served by the different sets of elements and different weaves, and illustrating some of the least complex of the structures that are typical. In other words, the following is meant to serve as a guide in analyzing *compound* fabric structures by providing a basis for determining the relationships between different sets of elements and the significance of each in the total weave structure.

1. COMPOUNDED BY ADDING SETS OF ELEMENTS

It has been noted (p. 74) that whereas *simple interlaced* structures are grouped according to certain characteristic orders of interlacing and types of interworking, *compound* structures can be further classified according to the divergent functions served by the various sets of elements. In those *compound* structures in which a *simple weave*, complete in itself, serves as a 'ground' or 'foundation' weave throughout, any additional sets (whether warp or weft) are clearly *supplementary*. Other *compound* structures, however, have at least two sets of one type of element (either warp or weft) that are *complementary* to each other and co-equal in the fabric structure. Such structures can be described as having *complementary* rather than *supplementary* sets of elements (see pp. 150 ff.).

NOTE: that according to some systems of classification, weaves with *supplementary sets* of elements are described as being (in the words of one author) "midway between 'simple' textures, which are composed of one series each of warp and weft threads, and 'compound' textures, which contain two or more series each of warp and weft, as exemplified in all double cloths" (Nisbet, 1919, p. 126). In other classifications they may be construed as variations of *simple weaves*; but in view of the way the term *simple weave* is usually defined, it would seem that a weave structure in which certain elements are *supplementary* to a *ground weave* is better classified (as is more customary) as a type of *compound-weave* structure.

A. SUPPLEMENTARY SETS

Supplementary sets of elements can be used to add decoration, 'backing,' reinforcement, or a 'facing' of either float or pile structure to a fabric. *Supplementary sets* may be warp or weft; more than one such set can be used, and more than one purpose served. Any weave *compounded* by the addition of *supplementary* elements will have a minimum of three sets of elements, and can be classified: 1) according to the function of the *supplementary set* (*patterning, backing*, etc.); 2) according to the structural nature of its use (*float, pile*, etc.); 3) according to its direction in the fabric (*warp* or *weft*); and 4) according to the structural relationship between the two faces (*single-faced, two-faced*, or *double-faced*). In the following discussion, the weaves are grouped primarily according to the function of the *supplementary set*, and secondarily according to the nature of the *supplementary structure*. The significance of direction (*warp* or *weft*) and the *identity* or *dissimilarity* of the faces of the weave structure will be discussed in connection with each function, but it can be said that, in general, weaves compounded by the addition of *supplementary* elements tend to be *two-faced*. (For the terms *single-faced, two-faced*, and *double-faced*, see pp. 164 ff.)

1. PATTERNING

EXTRA-WEFT *Supplementary*, or *extra, wefts* provide the simplest and least restricted means of adding *supplementary pattern* to a *ground weave*, since wefts can be added at will as the weaving progresses. Inasmuch as the basic structural require-

ments of a coherent fabric are fulfilled by a *ground weave*, the interlacing of *extra wefts* is not subject to any consistently applicable limitation. Consequently the ways in which *extra-weft patterning* can be produced are almost infinitely varied, as are the terms both for the means employed and for the resulting fabrics. It is possible, theoretically and mechanically at least, to add *extra-weft patterning* to any weave (*simple* or *compound*, whether *interlaced, crossed, twined, wrapped*, or *knotted*), and to utilize for the pattern the weft-interlacing order of any *simple weave* or any desired succession and arrangement of weft floats. But since *plain weave* is not only the simplest of all weave structures but also presumably the first to be used, and in general the most widely employed, as a ground for *supplementary-weft* structures, it will be used here as an unvaried ground on which to demonstrate varieties of *extra-weft patterning*.

Extra-weft patterning can be either 'area-patterning' or 'weave-patterning' (see p. 124), or a combination of the two. Pattern wefts may be *discontinuous*, that is, worked back and forth in limited areas to shape pattern units (e.g. figs. 220 and 221), or they may be *continuous*, that is, carried back and forth across the full width of the fabric. If *continuous* pattern wefts are used to produce *localized* pattern (i.e. pattern in certain areas only), they can be either floated free on the back of the fabric between pattern areas (e.g. figs. 224 and 225) or 'laid-in' with the ground wefts (figs. 226-229). *Continuous* pattern wefts can also be used to 'weave-pattern' a fabric, that is, to embellish it with patterning produced by variant interlacing orders (fig. 237, p. 146).

NOTE: that there is probably no type of *extra-weft patterning* that has not, at one time or another, been referred to as 'brocading,' although the term is quite commonly reserved for more specific reference to patterning with *discontinuous* extra wefts, or even further delimited in meaning. (For discussion of *brocade, brocading*, and related terms, see pp. 171 ff.)

The simplest *extra-weft patterning* structure is one often described quite literally as 'laid-in,' 'inlaid,' or 'inlay' (pp. 169 ff.). It is produced by 'laying' *supplementary wefts* along with the ground wefts in the regular sheds of a ground weave (fig. 220). The ground weave is usually, though not necessarily, *plain weave*, but if *plain*, the faces of the fabric are *identical* except where the pattern wefts are either carried from one area to another (fig. 226, p. 143) or from one shed to the next (fig. 220, right). The thread count of the ground weave is usually more or less balanced although the wefts may outnumber the warps. Obviously, with a *warp-faced* ground weave, 'laid-in' patterning would not be effective.

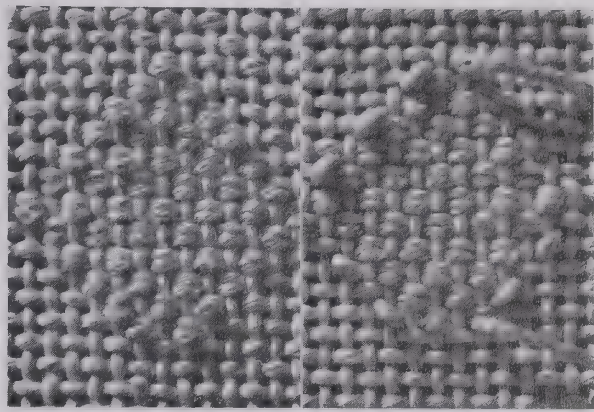

FIG. 220 The two faces of a fabric patterned in limited areas by *discontinuous* extra wefts 'laid-in' the sheds with the regular wefts of the *plain-weave* ground.

The visual and textural contrast between pattern areas and background can be considerably increased and a great variety of decorative effects obtained by the use of *floats*, that is, by allowing the pattern wefts to skip certain of the ground-weave bindings. In view of the innate structural relationship between a 3/1 order of interlacing and *plain weave* (see pp. 113 ff.), the early and always wide-spread use of the *3/1* order to add *extra-weft pattern* to a *plain-weave* fabric is to be expected. Whether the 3-span floats are aligned *vertically, diagonally* (e.g. fig. 221), or in *alternation* (e.g. fig. 233, p. 145), the bulk of the supplementary weft will lie on one face of the fabric, producing a *two-faced* structure. The interlacing

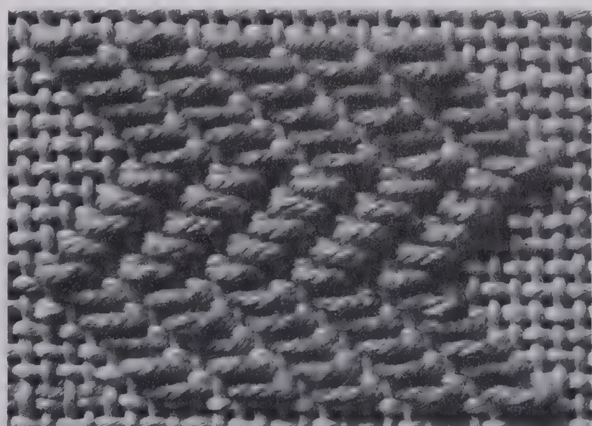

FIG. 221 Localized patterning made up of *diagonally* aligned 3-span floats of *discontinuous* wefts on a *plain-weave* ground.

in areas of diagonally aligned 3-span floats is often described as *3/1 twill*. This exemplifies the use of the weft-interlacing orders of *simple float weaves* for *extra-weft patterning* – usually on another weave (see pp. 146 and 147 for other *extra-weft twill interlacing*). When the interlacing order of one *simple weave* is used to pattern another, the interlacing of both pattern and ground can be controlled by heddles, but the shaping of pattern areas usually requires either manual, or more elaborate mechanical, control.

Extra wefts may be used to form patterns of floats of various lengths now on one face of the fabric, now on the other. Where they float on one face, the ground weave appears on the other and vice versa. Weaves constructed in this way are often described as 'overshot weaves' or 'overshot pattern weaves' (see pp. 122 and 173 for the terms). The floats can be aligned to form continuous vertical wales (figs. 222 and 223), or in blocks of various sizes and arrangements (typical of the patterns called 'Colonial coverlet' in America). Patterning of this sort, like 'patterning with another weave,' can be heddle-controlled and is usually extended the full width of the fabric, although it can be localized. The pattern of floats on one face is the negative or reverse of that on the other, and the weave structure is *two-faced*.

But in addition to patterns composed of relatively few simple units and therefore amenable to heddle control, *extra-weft floats* can be used freely in practically any desired arrangement of over-and-under interlacings. What is often described generically as *weft-float patterning* (see p. 170) falls into two general categories. In one, there are weave structures comparable to those referred to as 'overshot weaves' in that the *supplementary wefts* float on one face when not floating on the other and each face shows a pattern of floats that is the negative of the other (e.g. figs. 224 and 225). The term *overshot* sometimes describes this type of *weft-float patterning*.

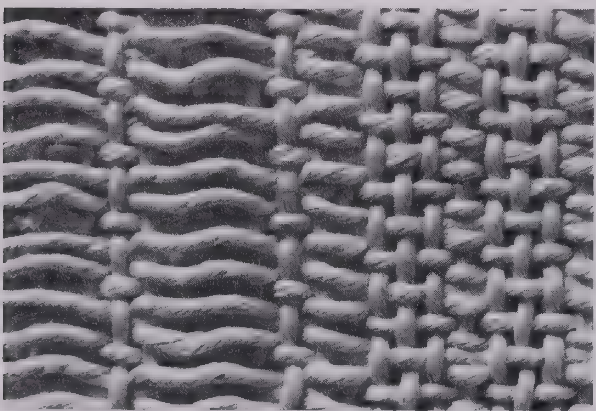

FIG. 222 One face of a fabric patterned by vari-length vertically aligned floats of *extra weft* on a *plain-weave* ground.

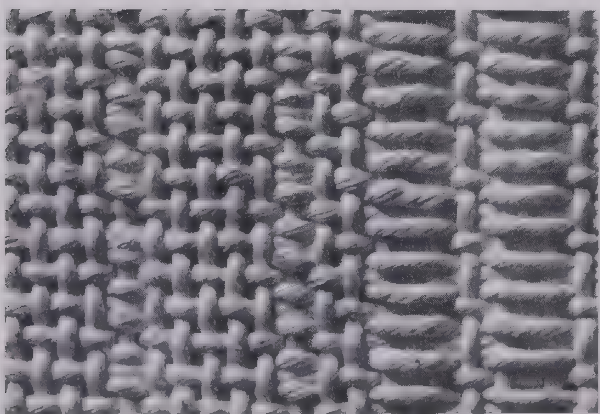

FIG. 223 Opposite face of fig. 222.

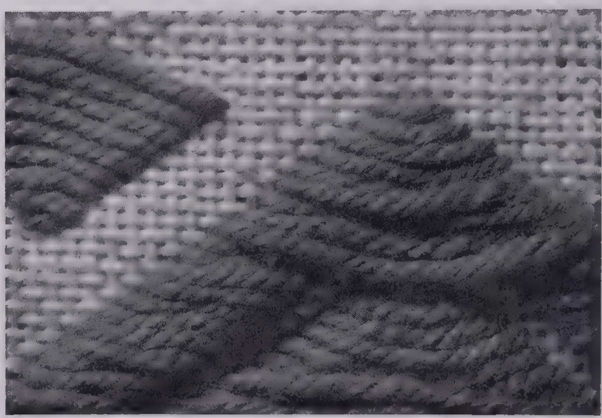

FIG. 224 Detail of a fabric patterned by a free arrangement of *extra-weft floats* on a *plain-weave* ground.

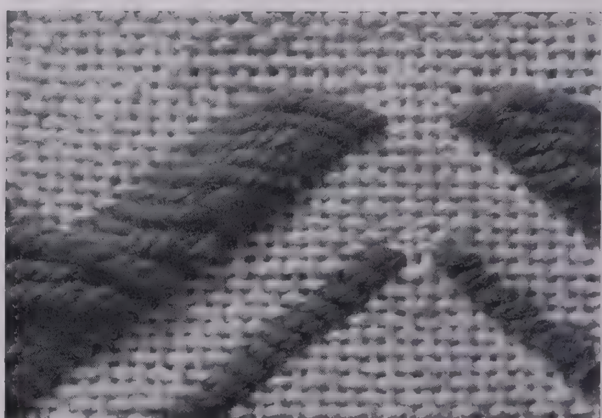

FIG. 225 Opposite face of fig. 224, showing the reversed pattern produced by the *supplementary wefts* which float on this face when not floating on the opposite one.

NOTE: that if two pattern elements are used and each duplicates on one face the action of the other on the opposite face, the structure will be *double-faced*; but, if a number of different-colored, but continuous, pattern elements are used concurrently, there may be little if any pattern visible in the mass of overlapping floats on one face of the fabric, and the fabric could presumably be described as *single-faced* in the sense of having only one finished and structurally integrated face (see p. 164).

In the second category of *weft-float patterning*, *supplementary wefts*, instead of floating on both faces of the fabric as described above, are interworked ('laid-in,' in fact) with the wefts of the ground weave wherever they are not floating on the face (e.g. figs. 226 and 227). In this type, floats of the *supplementary weft* can be used for the pattern, with the areas in which it is 'laid-in' forming the background — and the face shown in figure 226 (for example) would constitute the 'right side' of the fabric.

On the other hand, the areas in which the *supplementary wefts* are 'laid-in' with the ground wefts can serve as pattern areas, while those in which they float out of sight behind the ground weave serve as background. In that case, the face shown in figure 227 would be the 'right side' of the fabric, and the term *weft-float patterning* would be inappropriate because the pattern wefts, although floated, are floated on the back of the fabric between pattern areas and the patterning itself is of the 'laid-in' variety. It is, in fact, in this way that 'laid-in' patterning with *continuous* wefts is effected.

NOTE: that if the ground weave is *warp-faced* and the pattern wefts are alternately floated and 'laid-in,' as in figure 228, the floats necessarily form the pattern since, wherever the *supplementary wefts* are 'laid-in' with the ground wefts, both are concealed by the warp.

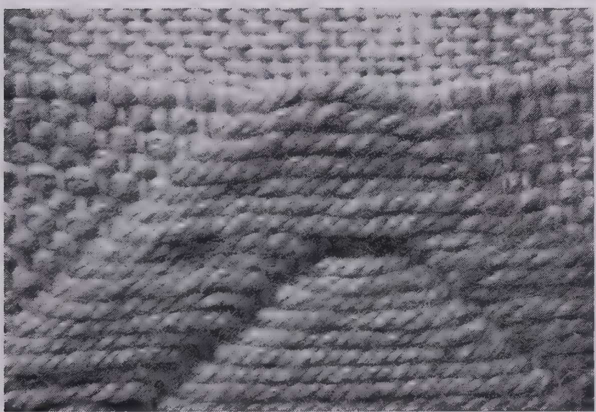

FIG. 226 Detail of a *plain-weave* fabric patterned with *supplementary wefts* which are floated in certain areas and carried in the same sheds with the ground wefts (i.e. 'laid-in') between float areas.

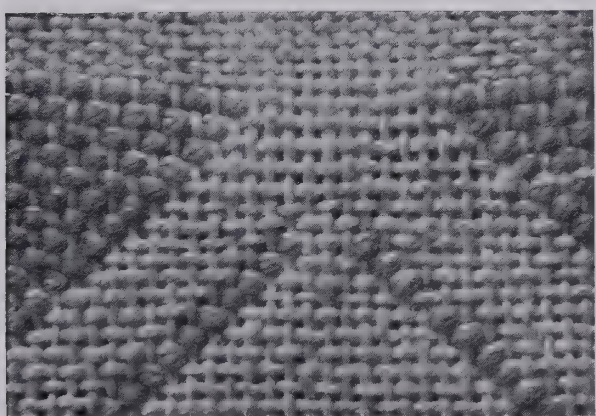

FIG. 227 Opposite face of fig. 226. The 'laid-in' areas are *identical* on the two faces. The areas of *extra-weft* floats in fig. 226 are countered on this face by areas of the *plain-weave* ground.

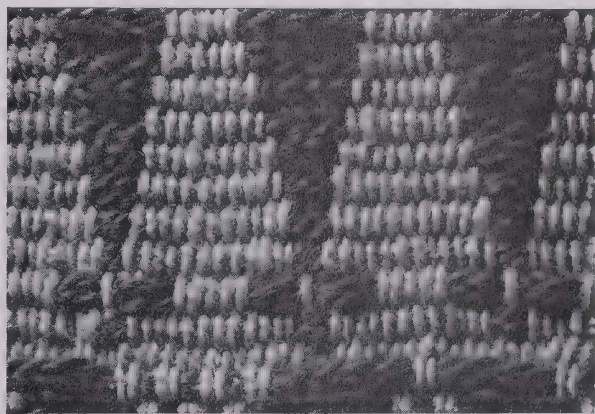

FIG. 228 Floats of paired *supplementary wefts* patterning a *warp-faced plain-weave* ground. (Detail of a tent strip from Turkestan, T.M. R4.37.)

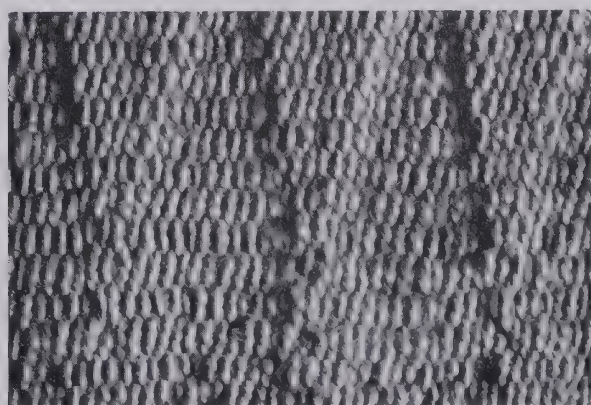

FIG. 229 Opposite face of fig. 228. The *supplementary wefts* are concealed by the warps of the ground weave.

EXTRA-WARP Patterning by means of *supplementary*, or *extra, warps* cannot be as spontaneous as *extra-weft* patterning because all warps must be in place on the loom before weaving starts. Nevertheless, in most non-mechanized weaving, *supplementary warps* can be manipulated with considerable freedom by fingers, 'pick-up stick,' or more mechanical means, to effect variations in both pattern and pattern structure.

Although the methods of production are entirely different, most *extra-weft-pattern* structures are duplicated, except for the warp-weft orientation, by structures used in *extra-warp patterning*. One notable exception is the intermittent use of *discontinuous* pattern elements to produce discrete areas of design. This is one of the most flexible and widely used methods of localized *weft patterning* (see, for example, figs. 220 and 221, p. 141) but for obvious reasons does not lend itself to *warp patterning*. However, localized patterning can be produced on one face of a fabric with *continuous* instead of *discontinuous* pattern elements if they are allowed to float free on the reverse of the fabric structure wherever they are not interworked to form the pattern. This is as feasible with *supplementary warps* (fig. 230) as with *supplementary wefts* (see p. 143), and is the way that the *extra-warp patterning* equivalent of 'laid-in' *extra-weft patterning* is produced.

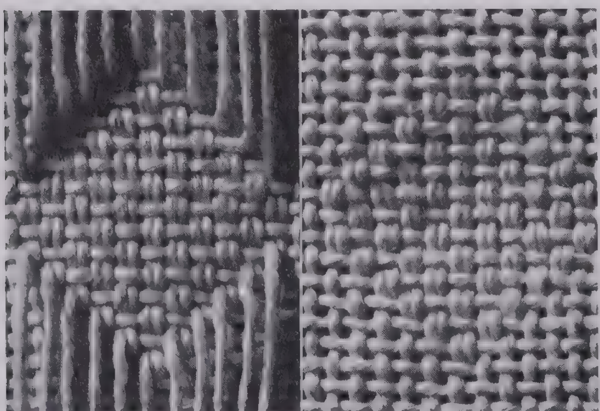

FIG. 230 Detail of the two faces of a fabric patterned by *supplementary warps* which float on one face when not paired with the warps of the *plain-weave* ground. Either face may be woven as the 'right side.'

NOTE: that the unattached portions of pattern elements that extend unused between pattern areas are sometimes cut away after completion of the fabric. Cut ends of pattern elements along the edges of pattern areas point to this as the probable method of construction.

In a somewhat similar fashion a kind of warp patterning comparable if not equivalent to the weft patterning effected by tapestry-like inserts woven between two passages of weft (see fig. 108, p. 83) can be produced by *continuous* pattern warps. Brought to the face of the fabric between two regular ground-weave warps, the pattern warps are interworked briefly with the ground-weave wefts in the ground-weave order of interlacing – augmenting but in no way interrupting, altering, or concealing the ground weave itself (fig. 231). Thus the pattern may be said to be produced by 'warp inserts' with the pattern warps floating free on the back of the fabric between areas of 'insertion' (fig. 232).

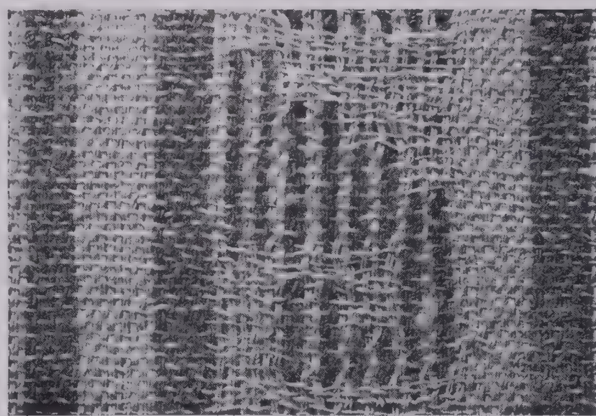

FIG. 231 One face of a *plain-weave* cotton fabric from Peru (T.M. 91.241) patterned by paired *supplementary warps* which are brought from the back of the fabric between adjacent *ground-weave warp* pairs to be interwoven with the *ground-weave wefts*.

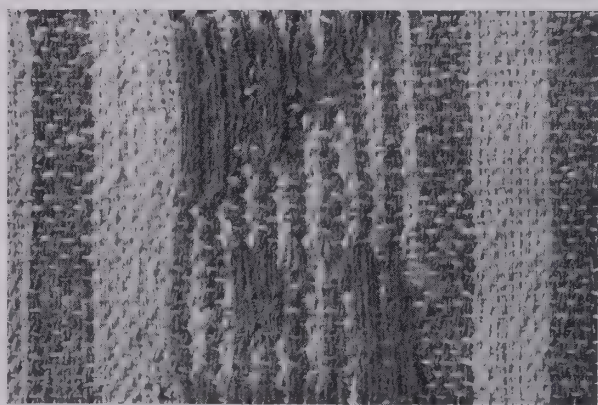

FIG. 232 Opposite face of fig. 231, showing the *supplementary warps* floating free between areas of interweaving.

It seems unnecessary to enumerate further details of the nearly complete correspondence between the structures of *extra-warp* and *extra-weft* patterning, since, except for the fact (referred to above) that

pattern warps must for practical purposes be *continous*, there are probably no *weft-pattern* structures whose structural counterparts cannot be found in *warp patterning*, and vice versa.

NOTE: that the terms used for warp-pattern types often do not correspond to those used for equivalent types of weft patterning. Designations like 'laid-in' and 'overshot' that are more or less descriptive of methods of weft patterning may not seem appropriate for warp patterning; but the use wherever possible of equivalent terms for equivalent structures will serve to indicate the analogous relationship between *warp-* and *weft-patterning*. (The use of the term *brocading* in reference to localized *warp patterning* is discussed on p. 172.)

2. FACING, BACKING, REINFORCEMENT

There are many weaves in which *supplementary sets* of elements are added to a ground weave for purposes other than patterning. Although more often and more significantly used on the face of the fabric to provide some particular surface quality, color, or texture, *supplementary elements* may be interworked at the *back* or *within* the fabric to add strength or weight without affecting the surface appearance.

If *supplementary elements* are hidden within a fabric, the weave of the fabric is often described as being *reinforced* (for discussion of the term as applied to *tapestry weave*, see p. 89); if they are visible only on what is clearly the 'wrong side' of the fabric, the fabric is usually referred to as 'backed'—'warp-backed' or 'weft-backed' according to the direction of the auxiliary elements. (Since these uses of *supplementary warps* and *wefts* differ from other uses chiefly in purpose and in qualitative effect rather than in structure, they are not illustrated.) If, on the other hand, *supplementary elements* are used to add a surface texture, whether of *floats, loops*, or *cut-pile*, to what is clearly the 'right side' of a fabric, the fabric is usually said to be 'faced' rather than 'backed.' (For use of the terms *faced* and *backed*, see p. 169.) The addition of *reinforcing* elements seldom affects the appearance or the essential structure of either face of a weave, and a weave that is structurally *identical* on the two faces will remain so when reinforced. But it is obvious that if *supplementary elements* are used to add 'backing' or 'facing' (and especially if they constitute 'pile'), the weave structure will almost inevitably have *dissimilar* faces and will, therefore, be *two-faced*. Only if the ground weave is 'faced' and 'backed' by identical structures, will the weave be *double-faced* (see pp. 164 ff.).

FLOATS *Floats* of *supplementary elements* (either warp or weft) can be used to add 'facing' or 'backing' to a ground weave and can sometimes be cut to form 'cut-pile.' One of the most elementary ways of 'facing' a *plain-weave* ground is by *floating* supplementary wefts over alternate bindings of the *plain weave*, that is, by means of 3-span weft floats which, as when used for *patterning* (see p. 141), may be aligned vertically, diagonally (fig. 236, p. 146), or in alternation (fig. 233). As has been noted, *3/1 interlacing* of a *supplementary element* throws the bulk of it to one face of the fabric. However, the extent to which it hides the ground weave on that face, as well as the extent to which it is visible on the opposite face (note figs. 233 and 234) will depend on certain largely qualitative relationships between it and the ground-weave elements.

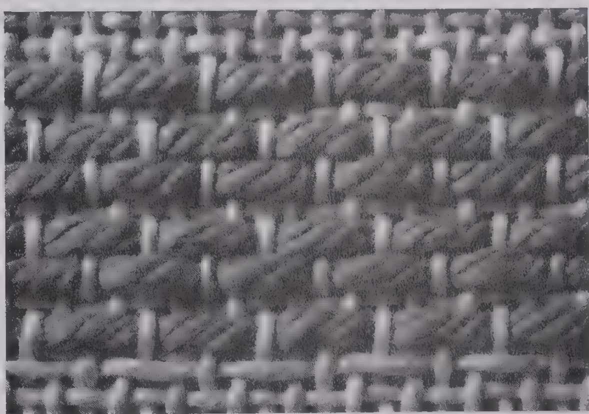

FIG. 233 Detail of a fabric 'faced' by 3-span floats of a *supplementary weft* in alternate alignment on a *plain-weave* ground.

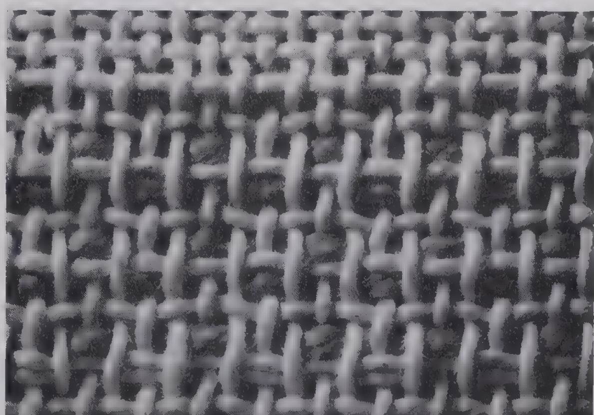

FIG. 234 Opposite face of fig. 233.

NOTE: that the basis for distinguishing the structure of the *compound* (*extra-weft*) *weave* illustrated in figures 233 and 234 on page 145 from that of the *simple weave* in figure 191 on page 114 lies in the fact that it is only in the *compound* structure that the 1/1 interlacing forms a complete and coherent *ground weave*. However, the two aspects of either structure – *simple* or *compound* – can be 'counterchanged' to create 'area-patterning.' Pattern areas delineated by the color and texture contrast created when the bulk of *supplementary* 'facing' elements (in a *compound* structure) is shifted from one face of the fabric to the other (see fig. 235) are found in a variety of weaves of different degrees of complexity, among them some of those known in America as 'Summer and Winter' weaves. (For use of the term, see p. 170.)

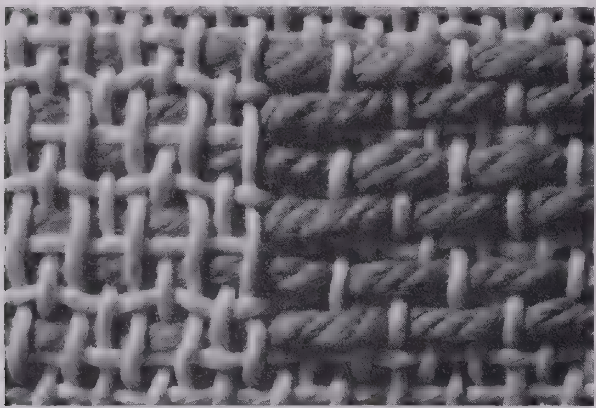

FIG. 235 Showing how the weave structure of a fabric 'faced' by a *supplementary element* in *3/1 interlacing* can be 'turned' for patterning purposes.

'Facing' a *plain weave* with 3-span floats of a *supplementary* element in *diagonal* alignment (fig. 236) is tantamount to adding a 'facing' of *3/1 twill* to a *plain-weave* ground; and inasmuch as there is a degree of pattern (if only the appearance of parallel diagonals) inherent in any regular *twill* order of interlacing, *supplementary elements* continuously interlaced in an *uneven-twill* order will have the effect not only of 'facing' the ground weave but of 'weave-patterning' the fabric to some extent.

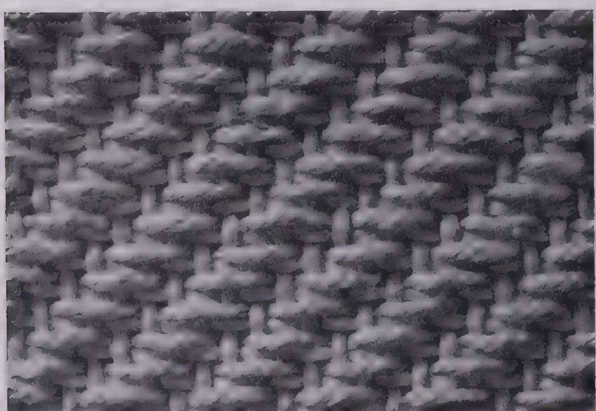

FIG. 236 Detail of a fabric having a *plain-weave* ground 'faced' by *diagonally* aligned 3-span floats of a *supplementary weft*. The two faces are *dissimilar*.

This use of a *supplementary set* of elements in an *uneven-twill* order 'faces' (and 'patterns') one side of the ground weave; but if the *supplementary twill* order is *even* and the ground weave, too, has *identical* faces (as in fig. 237, for example) both sides of the fabric will be equally 'patterned' and equally, albeit incompletely, 'faced,' and the purpose of the *supplementary element* will be more apt to be construed as 'patterning' than as 'facing.'

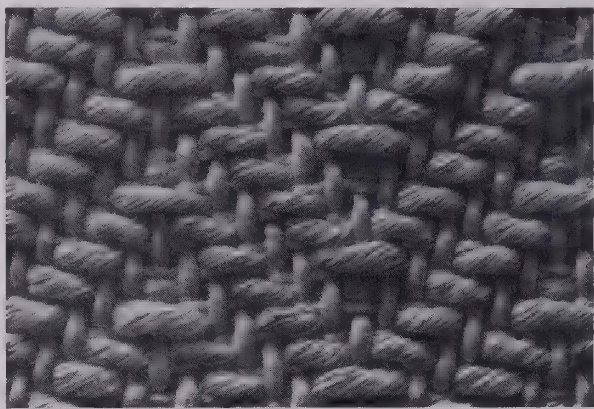

FIG. 237 A fabric with *supplementary wefts* woven in *2/2 vertical herringbone twill* on a *plain-weave* ground. The two faces are *identical*.

Obviously there can be more than one entirely valid way of 'interpreting' the part played by *supplementary sets* of warp or weft. However, such variations need not compromise the accuracy of essential information about a fabric. If information is precise and detailed enough, it can usually be correctly fitted into whatever categories may be set up for comparative studies or statistical compilation.

The combination of 6/2 and 2/2 *twill* orders of interlacing shown in figures 238 through 241 illustrates the possibility of different but equally justifiable interpretations. Although it would be both natural and reasonable to 'interpret' the simple *2/2 twill* as a 'ground weave' and the weft that interlaces over-6-under-2 in a regular twill progression as 'supplementary,' it is easy to conceive a *6/2 twill* ground weave with a *supplementary weft* interlaced in *2/2 order* to add weight, bulk, or some other quality to

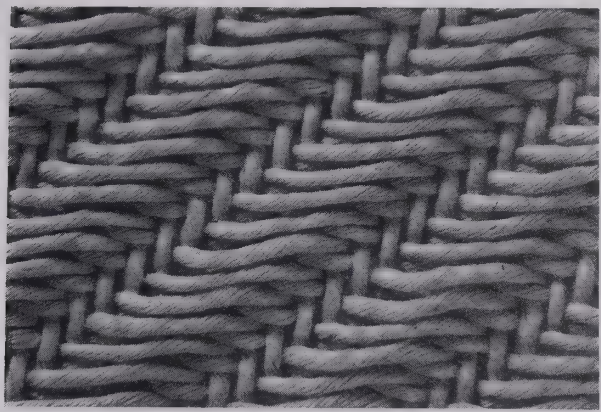

FIG. 238 The *6-span weft-float* face of a fabric in which one set of warps is interlaced by two sets of weft; one (presumably the *ground-weave* weft) in *2/2 twill*, the other (presumably *supplementary*) in *6/2* order.

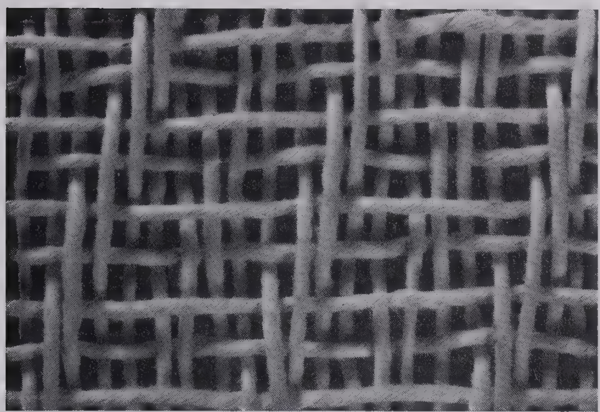

FIG. 239 Diagrammatic construction of fig. 238, showing the alternation of the two sets of weft, one interlacing the warp over-6-under-2, the other over-2-under-2, both in the same *diagonal* alignment.

the 'back' of a fabric. Furthermore, while a *supplementary weft* interlacing in *6/2 order* could very well be construed as a 'facing' element which gives a 'pattern' of strong diagonals to the fabric, it is not uncommon to find similar long floats used to 'back' a fabric. Often the most definitive clue to the purposive use of a *supplementary set* of elements is to be found not in the actual structure of the fabric but in certain qualitative characteristics of the *supplementary elements* in relation to those of other sets. But when neither set seems subordinate or *supplementary* to the other, while at the same time each forms a complete weave structure in its interlacing with the warp set which serves them both, the term *two-weft twill* proves useful, in that it suggests two different weft functions without arbitrarily naming them. On the other hand, when alternate warps are

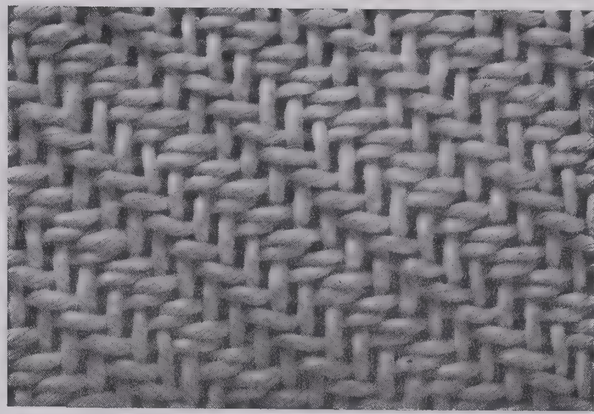

FIG. 240 Opposite face of fig. 238, showing only *2-span weft floats.*

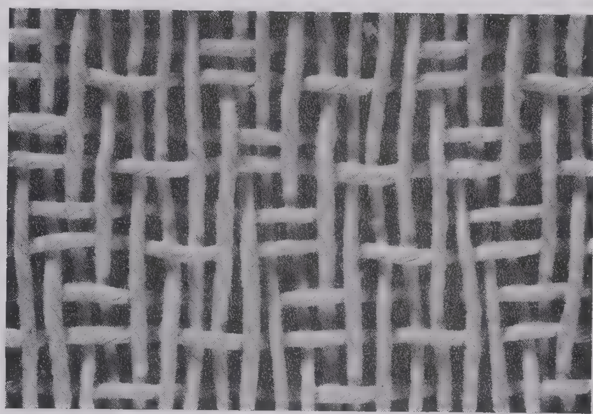

FIG. 241 Diagrammatic construction of fig. 240, showing the *2/2 twill* interlacing order of alternate (presumably ground) wefts. (Opposite face of fig. 239.)

used for one *simple twill* and the intervening ones for another, the fabric has, in effect, two sets of warp as well as of weft and would be classified as an *integrated compound weave* (see p. 159).

NOTE: that in the study of textile fragments that have suffered qualitative as well as quantitative loss and degenerative change, it may be possible to determine the number of sets of elements in a fabric and to identify their respective orders of interlacing without being able to determine their original functions or orientation (warp or weft), or to know which face, if either, was intended as the 'right side.'

Although only *extra-weft* 'facing' structures have been discussed and illustrated, their *extra-warp* counterparts should be assumed, since, as in *patterning* (see p. 144), there is theoretically at least an *extra-warp* counterpart or equivalent for any *extra-weft* structure used for 'facing' or 'backing.'

WOVEN-PILE Perhaps the most elementary method of producing a somewhat pile-like texture in a fabric is to secure unspun tufts or 'flocks' of fiber in the fabric structure as it is formed by allowing portions of them to lie in the regular sheds of a weave (or in any interworking of elements used to construct a fabric) with one or both ends hanging free. But this tends to produce a shaggy surface quality that is not typical of 'pile' as generally conceived, and both fabric and surface quality are often described as 'tufted,' or, occasionally, as 'floccose.' (Unspun wool has been used in this manner to produce fabrics with something of the appearance of animal pelts, and such wool-tufted fabrics have presumably served on occasion as imitation pelts.) Short lengths of spun yarns are sometimes similarly used but usually with quite different effect. Elongated ends may be dispersed, as 'tags,' or arranged in lines as fringe, and to these and other uses the term *tufted* is not usually appropriate (see p. 173 for the terms *pile* and *tufted*). On the other hand, a description of "tufts" of wool being "wrapped twice about every other warp in each alternate shed as the weft was laid in" (Bennett and Bird, 1949, p. 290) suggests a rudimentary form of the 'knotted-pile' technique (see pp. 223 f.).

NOTE: that the technique of producing so-called 'knotted-pile' by wrapping the pile element round the warp elements instead of laying it in certain sheds of a ground weave is a form of *wrapping* rather than *interlacing* and is discussed from page 221 on.

But it is in the technique of repeatedly securing continuous lengths of *supplementary warp* or *weft* in the interlacing of a ground weave — with portions freed, or left free, to stand out from the plane of the underlying fabric — that we find the basic forms of 'woven-pile' and the fundamental principles on which the weaves commonly employed for many so-called 'pile fabrics' (such as velvet, plush, terry, and so on) are constructed. (For use of the term *woven-pile* and the names for various 'pile fabrics,' see pp. 174 ff.)

> *Pile:* loops or ends of yarn or fiber projecting from the plane of a fabric to form a raised surface (which tends to conceal the foundation fabric in which the yarns or fibers are secured).

The simplest and what was very probably the earliest form of the 'woven-pile' (as distinguished from the 'knotted-pile') technique is a form of *structural pile* which can be described as 'laid-in' or 'extra-weft-loop' pile. Portions of a length of *supplementary weft* lying in a shed of the ground weave are drawn from the surface of the fabric at intervals to form loops (see fig. 242). Although the essential structural principles of 'structural woven-pile' are exemplified in this simple form, there are many variables. The spacing, arrangement, and length of the loops are subject to almost unrestricted variation; the loops can be of either warp or weft; they can be cut, left uncut, or cut in some areas and not in others (with the contrast between textures used for 'area-patterning'); they can be used only in certain areas or to form the whole surface of the fabric; and further embellishment can be added by means of 'brocading' wefts or other *supplementary elements.* The foundation weave of the fabric can be *plain weave, twill, satin,* or any weave suited or adaptable to the

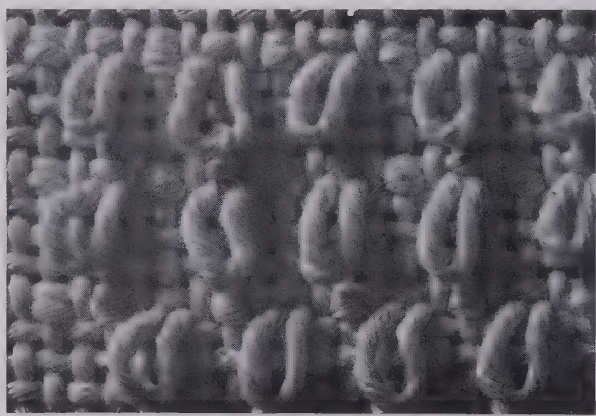

FIG. 242 Diagrammatic construction illustrating the principle of structural pile: loops of *laid-in supplementary wefts* project from a *plain-weave* ground to form *weft-loop pile.*

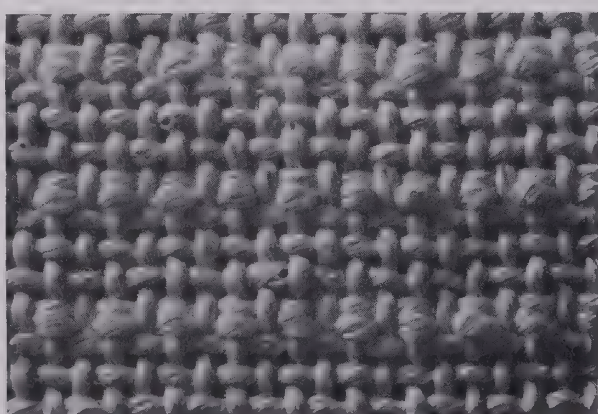

FIG. 243 Opposite face of fig. 242.

purpose — although *plain weave* seems to be quite consistently used as the ground for 'looped' pile.

NOTE: that a major form of patterning in *structural-pile* weaves is 'area patterning' (i.e. patterning created by textural contrast between areas) and is of three major kinds: patterning formed by contrasted areas of *pile weave* and flat interwoven ground (see p. 143 for comparable 'float' patterning); patterning formed by areas of pile of different lengths ('pile-on-pile'); and patterning formed by contrasted areas of 'cut' and 'uncut' pile. (For terms like *voided velvet* and *pile-on-pile*, see p. 174.)

The usual method of producing *non-structural pile* consists of cutting *floats* formed by a *supplementary element.* Although a weave that has been *compounded* by supplementing a ground weave with floats of an extra element is not in itself a *pile weave*, it may be woven in such a way that *pile* can be produced by a subsequent process — that is, by cutting the floats. (The height of the cut pile produced in this way depends solely on the length of the floats.) But if a weave is compounded by supplementing a ground weave with *loops* (of whatever length required) formed by an extra element, *pile* is a *structural* feature of the weave (and the elements that form the pile loops must have sufficient extra length to provide for them). In short, *loops* of a *supplementary element* necessarily project from the plane of the ground weave and constitute what may be termed *structural pile*, whether cut or uncut; whereas *floats* remain floats and form a flat 'facing' over the ground weave unless or until they are cut to form *non-structural pile*. Thus *structural pile* is pile formed by and in the process of constructing the fabric, and exists as *pile* (whether cut or not) by virtue of the distinctive structure of the fabric, independent of the non-weaving and often post-weaving process of cutting. But when *pile* is formed by cutting *floats* of a *supplementary element*, the fabric does not become a *pile fabric* unless or until the floats have been cut, the *pile* being then *non-structural*, that is, the result of an extra process which gives to a regular weave structure this special 'effect.'

Another method of producing *woven-pile*, which also relies on the supplemental process of cutting to produce what can be classified as a *pile fabric*, is more complex and is primarily a machine method. Actually 'double-woven,' and augmented by an *extra set* of 'pile' elements, the fabric — until subjected to the cutting process — is without visible pile and exists as a *double-cloth* (see pp. 155 ff.) interworked by one *supplementary set* of elements. To be specific, two distinct weave structures, each having its own sets of warp and weft, are produced simultaneously, one above the other, while a common set of *supplementary elements* constantly passes back and forth from one weave structure to the other, interworking with both. When cut apart, each weave structure has, on what was its inner face, *pile* formed by the cut ends of the common *supplementary element*; and the fabric structure is no longer a *double-cloth.* It now comprises two separate *pile fabrics* in which little if any evidence remains of the time- and labor-saving method by which both were woven at the same time. Use of the term *double* in describing fabrics woven in this way (e.g. 'double velvet,' 'double plush,' or 'double-pile' fabric, p. 174) often misleadingly suggests that the fabrics are *double-faced* (i.e. that they have pile on both sides); whereas when finished, these fabrics are no longer in any sense 'double' although they can be accurately described as having been *double-woven* (see pp. 167 f.).

Adaptability to mechanization is probably the chief merit of the 'float,' as well as of the 'double-cloth,' technique of weaving *pile fabrics*, and both techniques were presumably developed in response to demands for economy of time and effort. It is noteworthy that *weft-loop pile* is not produced mechanically and survives largely in 'hand weaving'; whereas practical mechanical means for creating *extra-warp loops* (and for cutting them where and when desired) were devised early in the mechanization of weaving processes and were gradually refined and elaborated through the years. As a result, most mechanically produced *warp-pile* fabrics ('velvet,' 'plush,' 'terry,' 'Brussels carpets,' etc.) are *structural pile*; whereas such machine-made *weft-pile* fabrics as 'velveteen' and 'corduroy' have *non-structural pile*, being woven with *extra-weft floats* which are subsequently cut. (For the terms *velvet, velveteen*, etc., see pp. 175 f.)

NOTE: that an effect of 'pile' is sometimes produced in primitive technologies by using narrow strips of fur (either wound spirally on a fiber core or spiralled in drying to form a fur-covered cylinder) as warp elements in *weft-twining*; and in modern industrial technologies by using 'chenille' yarns (which are in a sense 'cut-pile' yarns) as interlacing elements in loom weaving.

B. COMPLEMENTARY SETS

When two or more sets of elements have the same direction in a fabric and are co-equal in the fabric structure, they can be described as being *complementary* to each other. The structure itself is *compound* and can be either *double-faced* or *two-faced*.

DOUBLE-FACED WEAVES With an *uneven* order of interlacing, a set of *supplementary elements* can be made to 'face' one side of a ground weave (see p. 146). But if the opposite side as well is similarly 'faced' in an identical *uneven* order by a corresponding set of elements, the ground-weave set having the same direction may no longer be necessary to the coherence of the fabric structure. In other words, two *complementary sets* of elements having one direction can interlace with a single set in the other direction to form a coherent weave structure in which there is no 'ground weave' that can be singled out as such and no one set of elements that is 'supplementary' to the others. Instead, two sets of elements play equivalent and reciprocal parts on opposite faces of the fabric, and the weave can be classified as a *double-faced* weave with *complementary sets* of either *warp* or *weft* elements.

In the simplest form of such a weave, both *complementary sets* maintain a 3/1 order of interlacing and form 3-span floats in *alternate* alignment, each on its own face. There can be two sets of warp and one of weft, as in figures 244, 245, 250, and 251, or two sets of weft and one of warp (figs. 246-249). One of the advantages of *double-faced* weave structures, generally, is that color, fiber, and/or texture can differ on the two faces of the fabric, and it is obvious that if *complementary sets* are sufficiently compacted the color and quality of the set forming one face would have little if any effect on the appearance of the opposite face. When the *comple-*

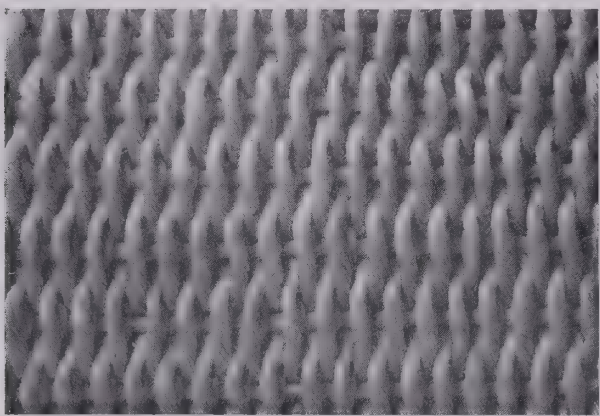

FIG. 244 A *double-faced* weave structure, both faces of which are formed by 3-span *warp floats* in *alternate* alignment. The warps are compacted sufficiently to nearly hide those which form the opposite face.

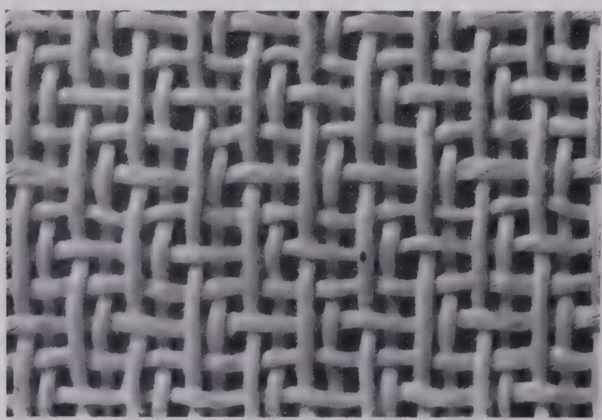

FIG. 245 Diagrammatic construction of fig. 244.

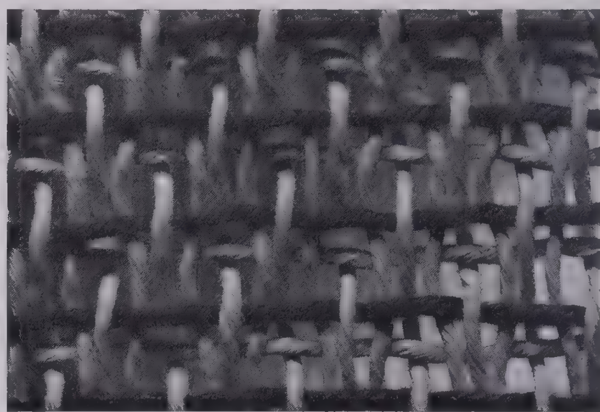

FIG. 246 Diagrammatic construction of fig. 248. A *double-faced* weave structure, each face of which is formed by 3-span *weft floats* in *alternate* alignment.

FIG. 247 Diagrammatic construction of fig. 249. Opposite face of fig. 246. The structure is the same but the weft color differs.

mentary sets are *weft sets* (figs. 246 and 247) the contrast between the two faces will inevitably be more marked if the fabric is *weft-faced*; with *complementary warp sets*, complete color contrast can be achieved only if the fabric is *warp-faced*. But the ratio of predominance of each of the *complementary sets* over the opposite set (or vice versa) is variable, causing wide variation in the appearance of the fabric without altering the actual weave structure. For example, figures 248 and 249 show the 'dark' and 'light' faces of the *complementary-weft* structure diagrammed in figures 246 and 247 when the wefts on each face outnumber but do not conceal the warps. Figures 250 and 251 show the two faces of the *complementary-warp* structure diagrammed (without color variation) in figure 245 when one set of warps is dark and one light but when each is outnumbered by the wefts. (The ratio of weft predominance is approximately the same in figs. 250 and 251 as it is in 248 and 249, but in one case the *complementary sets* are *warp sets*, in the other, *weft*.)

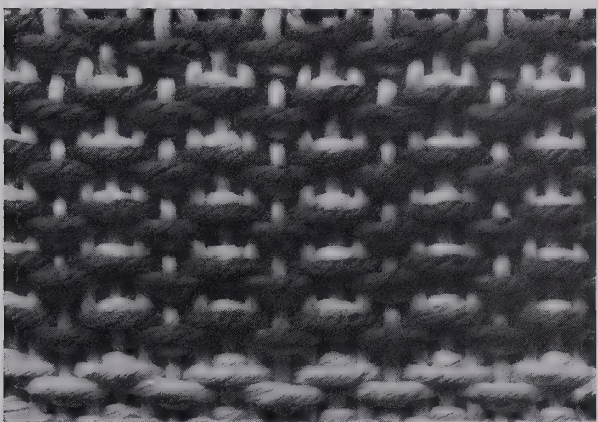

FIG. 248 Showing one face ('dark') of the *double-faced* weave structure diagrammed in figs. 246 and 247 when the *wefts* of the *complementary sets* outnumber but do not conceal the *warp*.

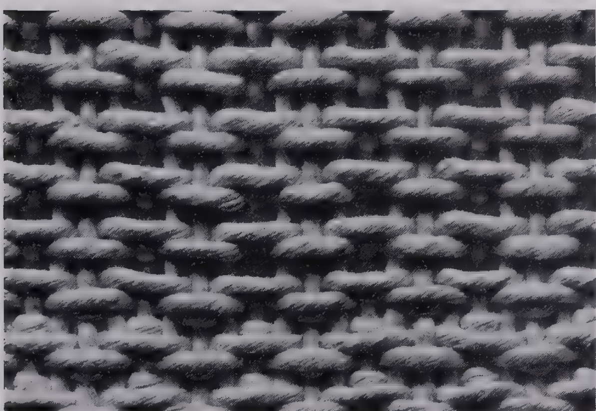

FIG. 249 Opposite ('light') face of fig. 248 (diagrammed in fig. 247).

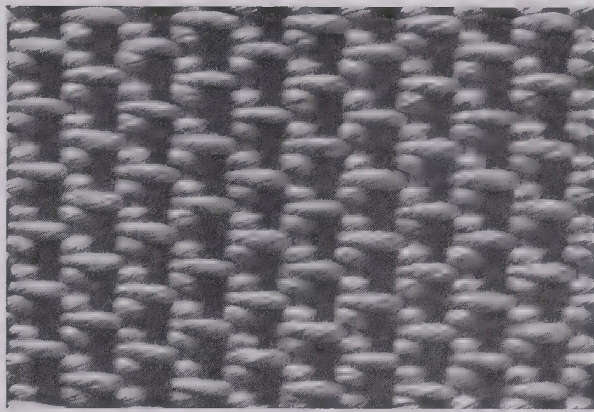

FIG. 250 Showing one face ('dark') of the *double-faced* weave structure diagrammed in fig. 245, when the *warps* of the *complementary sets* (one dark and one light) are more widely spaced than the *wefts* of the single set.

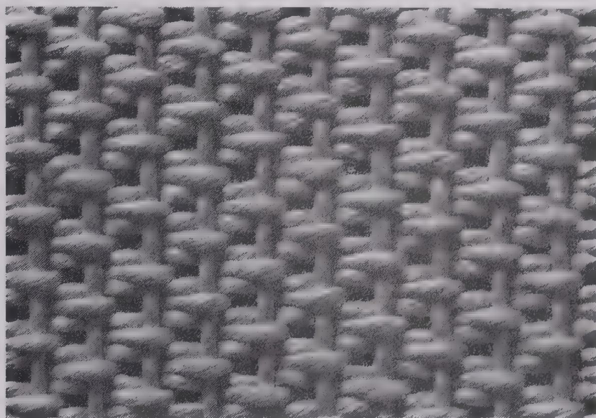

FIG. 251 Opposite ('light') face of fig. 250.

When the elements of the two *complementary sets* conceal those extending in the opposite direction, it is easy to produce a fabric with different colored faces; and given this means of constructing a two-color fabric, the idea of interchanging colors between the two faces follows logically and opens up almost unlimited patterning possibilities. True, in the basic 3-set form of the fabric structure, with one of the *complementary sets* of one color and the other of another, only two-color patterning is possible; but if three or more *complementary sets* are used instead of only two, patterns in three or more colors can be achieved. It should be noted, however, that, when more than two *complementary sets* are used, there will always be at least two acting together on one face of the fabric. The pattern areas and the interlacing order of the weave may still be

identical on the two faces; but on the face on which elements are combined, the clarity of the color delineation will be reduced and the structural identity somewhat modified – although it is doubtful if the faces should be considered structurally *dissimilar* as long as the order of interlacing is unchanged. (See p. 153 for description and illustration of a fabric in which the structure of one face is altered by the use of multiple wefts in a *complementary-weft* structure.)

NOTE: that with the elements of the *complementary sets* compacted, *alternate* alignment of 3-span floats will give a fabric an appearance of *plain weave – warp-faced* or *weft-faced* as the case may be – a fact that is reflected in the use of terms like *double-faced plain weave, double-faced tapestry, compound tabby,* and *reversible tabby,* and to a certain extent in the term *Chinese warp-rib.* (See p. 166 for various terms for this structure.) Note, too, that it is possible, with *complementary sets* of *weft* in a *weft-faced* fabric, to use discontinuous wefts and, without interchanging them between faces, to produce tapestry-like patterning on one face, with the other face plain or weft-striped, in a fabric structure sometimes described as 'double-faced tapestry,' sometimes as 'two-faced tapestry.'

If separate sets of elements having the same direction are used to form 3-span floats in *diagonal* alignment on each face of a weave structure, the weave is in effect a *double-faced 3/1 twill* (see figs. 252 and 254), sometimes inadequately described as a 'compound twill.' Conceivably the structure could be construed as a *3/1 twill* ground weave, either 'faced' or 'backed' by a *supplementary element* in *3/1 twill* interlacing (see p. 146). But structurally the two sets of elements are exactly equivalent and in all ways *complementary* to each other; and as long as there is no structurally distinguishable 'ground weave' and no set of elements that is clearly 'supplementary,' such a twill is better classified as having

FIG. 252 The 'dark' face of a *double-faced* weave structure with *complementary sets* of *weft* (one dark and one light) in *3/1 twill* interlacing on each face.

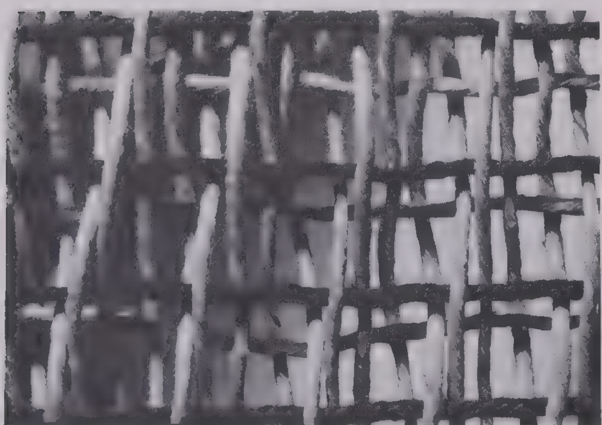

FIG. 253 Diagrammatic construction of fig. 252.

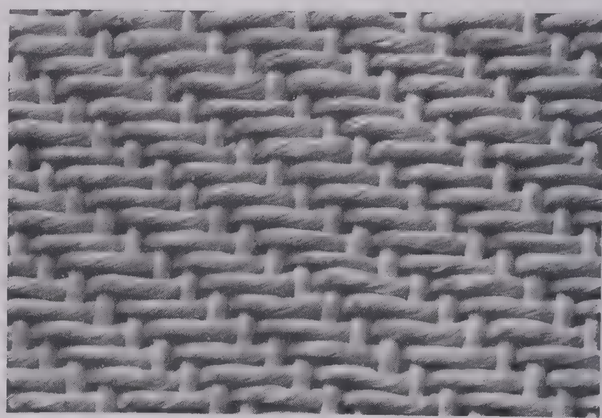

FIG. 254 Opposite ('light') face of fig. 252.

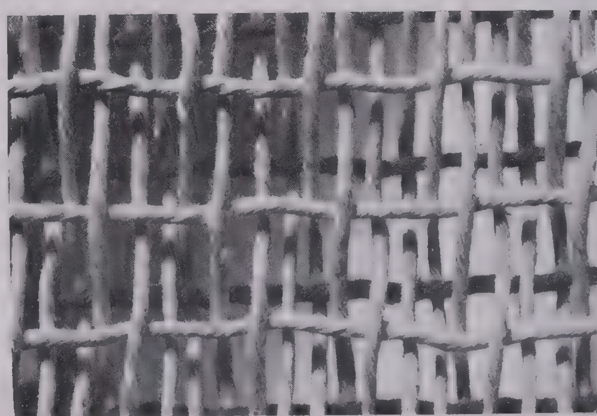

FIG. 255 Diagrammatic construction of fig. 254. Opposite face of fig. 253.

'complementary' rather than 'supplementary' sets. This would be in line with the requisite classification of another *double-faced* weave related to *3/1 twill* in both appearance and structure, one in which 5-span floats, although in *diagonal* alignment on both faces, do not actually form a *5/1 twill.* The *diagonal* alignment of floats is developed by successive binding, not of adjacent elements, as in a true twill, but of alternate ones (see figs. 256 and 257). The intervening elements do not interwork on either face and are sometimes construed as a fourth ('inner' or 'inactive') set, differentiated in function from the set that binds the floats (as are alternate warp elements in fig. 245 and alternate weft elements in figs. 246 and 247, p. 150).

NOTE: that a *double-faced complementary-weft* structure can be 'figured' by additional wefts (which are not *supplementary*) without interruption or alteration of the basic order of interlacing. The fabric in figures 258 and 259, for example, is basically a *double-faced complementary-weft diamond twill* into which 'figures' have been worked by substituting *discontinuous* wefts (of different colors) for certain wefts of the *complementary sets* in the regular *double-faced diamond-twill* weave order (fig. 258). Each regular weft, thus displaced, floats free on the reverse (fig. 259). Hence although the *double-faced complementary-weft twill* structure is unvaried and uninterrupted (showing only color variation on the right side), the total fabric structure is undeniably *two-faced* and the fabric itself, as far as use and appearance are concerned, could be qualitatively described as *single-faced.*

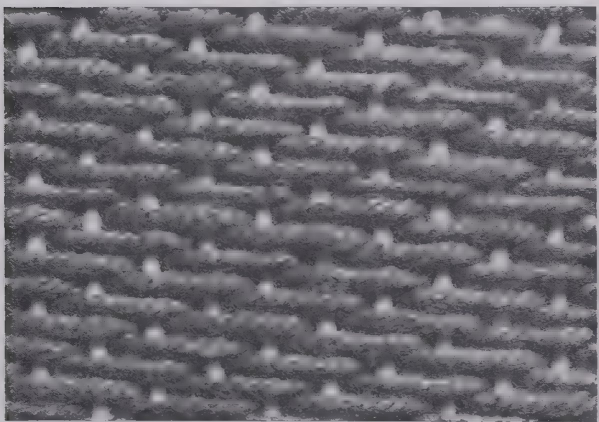

FIG. 256 One face of a *double-faced* weave structure with two *complementary sets* of *weft* (one dark and one light in this example) which form 5-span floats in *diagonal* alignment on each face. The opposite face is structurally *identical.*

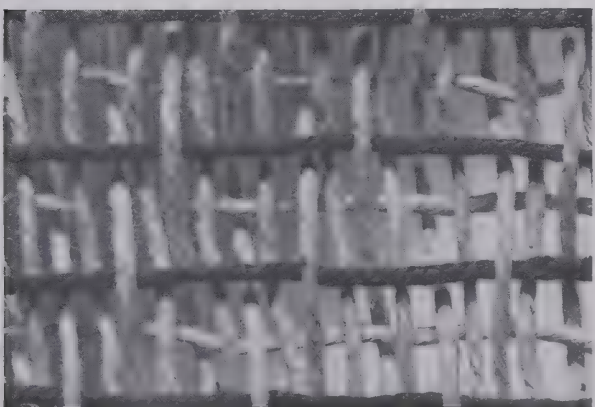

FIG. 257 Diagrammatic construction of fig. 256, showing alternate warps lying between the 'dark' and 'light' faces, not interworking with either face but serving to lengthen the floats on both.

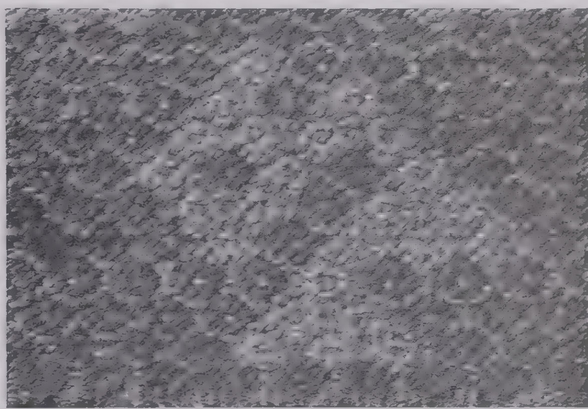

FIG. 258 Detail of a *weft-faced,* patterned, alpaca and cotton fabric from Peru (T.M. 91.612) woven in *double-faced complementary-weft diamond twill* and figured by substitution of different-colored discontinuous wefts for those of one of the *complementary sets* of the basic weave structure.

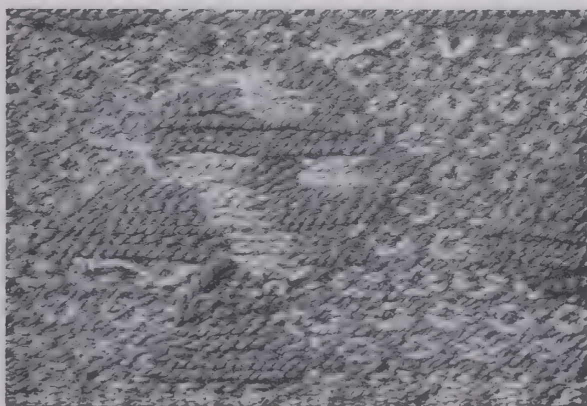

FIG. 259 Opposite face of fig. 258, showing wefts floating in areas where they are replaced in the basic weave structure by other wefts.

TWO-FACED WEAVES *Complementary sets* of either warp or weft can also be used in such a way as to produce a *two-faced* fabric. For example, certain ancient Peruvian fabrics with *weft-floats* in two-color patterning on one face and *plain weave* (also in two colors) on the other are constructed with two sets of weft and one of warp. Where one weft set forms pattern floats on one face, the other interlaces with the warp in *plain weave* on the opposite face, and vice versa. That is, one face of the fabric shows a two-color pattern of floats (fig. 260); the opposite, a uniform ground weave with the weft colors reversed (fig. 261). *Complementary sets* of warp can be similarly used with a single set of wefts; and whether the *complementary sets* are warp or weft, either face (float or interwoven) may serve as the 'right side' of the fabric. In one case floats form the pattern, in the other they are the means of getting elements from one pattern area to another (figs. 262 and 263).

FIG. 260 *Weft-float-patterned* face of a *two-faced* fabric woven with two *complementary sets* of *weft*, each of which forms float patterning in certain areas and elsewhere forms the ground weave. Detail of float-patterned alpaca coca bag from Peru. (Collection of Robert S. Sonin.)

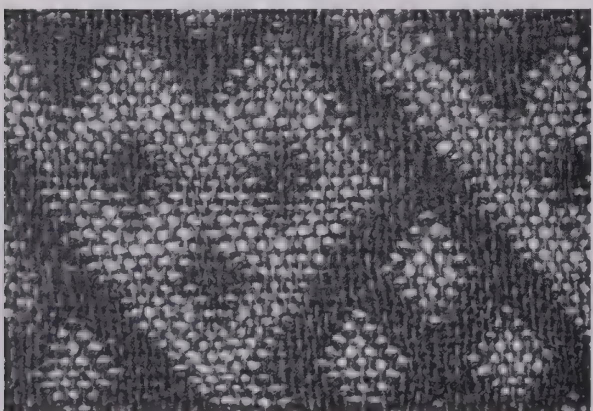

FIG. 261 Opposite face of fig. 260, showing the ground weave formed by the two sets of weft. The pattern areas appear on this face with the weft colors reversed.

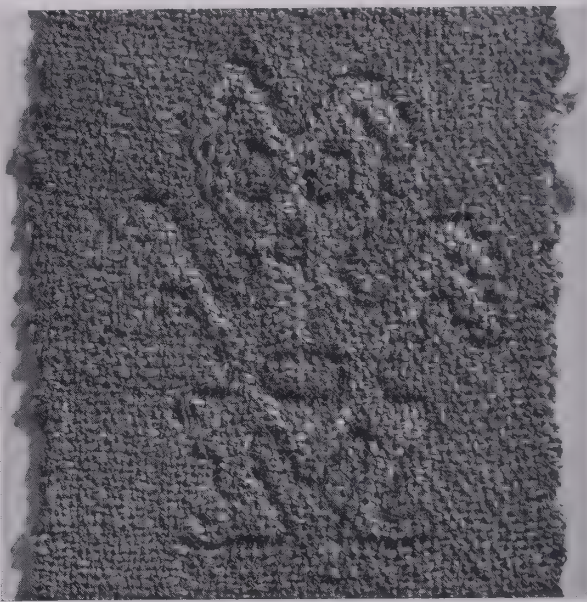

FIG. 262 'Right side' of a *two-faced*, patterned fabric constructed with *complementary sets* of *weft*, each of which interlaces the warp in *plain weave* in certain areas, and elsewhere floats on the reverse. Detail of alpaca fragment from Peru (T.M. 91.666).

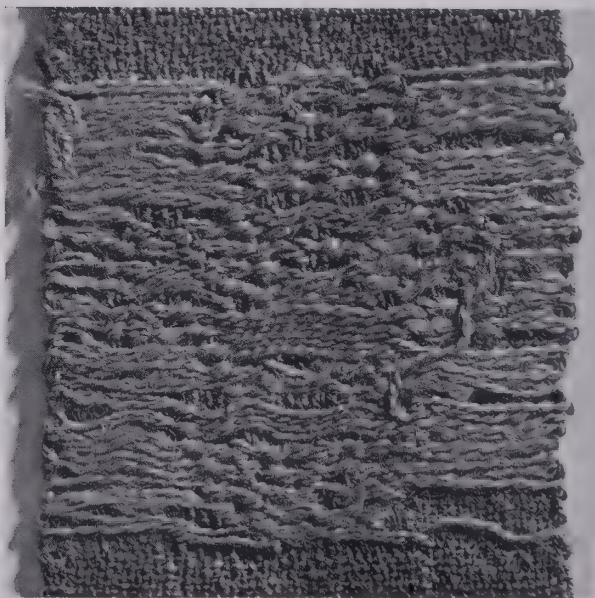

FIG. 263 Opposite face of fig. 262, showing the wefts floated between the areas where they interlace with the warp to form pattern or background on the 'right side.' The confusion of floats and the lack of definition of the pattern might cause the fabric to be qualitatively described as 'single-faced' (although structurally *two-faced*).

2. COMPOUNDED BY COMBINING COMPLETE WEAVE STRUCTURES

In contradistinction to the weaves discussed on the preceding pages, which can be constructed with a minimum of three sets of elements – that is, those *compounded* by the use of one or more sets of elements in addition to the two (warp and weft) required for any *woven* fabric – there are weaves that are *compounded* by combining two (or more) *complete weave structures* in which each set of warps is interlaced by its own set of wefts. These obviously require a minimum of four sets of elements, at least two in each direction. They can be classified not only according to the number of *complete weave structures* entering into the combination but, more significantly, according to the way the weave structures are combined. That is to say, weaves composed of two or more co-equal weave structures that are distinct from each other (being *interconnected* only at certain points) can be differentiated from weaves in which two or more weave structures (which may or may not be co-equal) are merged throughout in a single *integrated* fabric structure. All these weaves are sometimes found, loosely grouped, under the general heading *double weaves*, a term of many, and varied, uses – all of them lacking precise implications (see p. 168).

A. INTERCONNECTED WEAVE STRUCTURES

TUBULAR WEAVE Perhaps the most common and literal concept of a 'double weave' is that of two discrete webs, or layers, of fabric woven simultaneously one above the other. In constructing two identical layers of fabric, half of the warp elements (every other thread) serve as warp for one layer, the rest (the intervening threads) for the other. If a continuous weft element is interwoven with the warps of first one layer and then the other in an unbroken circuit, the result is a *tubular* fabric which in terms of construction is *compound*, although each weave structure in any given area is *simple*. Some will interpret such a fabric as one made up of two sets of warp (one for each layer or 'cloth') and one set of wefts, and may describe it as, for example, 'one-weft double-cloth.' But others, perhaps because of the double nature of the construction, will construe the same fabric structure as one made up of two sets of weft as well as warp (one of each for each layer or 'cloth') – in spite of the fact that the distinguishing feature of the fabric structure is the continuously circling weft which functions in both cloths and, by connecting them at both edges, creates an unbroken 'tube' of fabric. Thus construed, the fabric is usually described as 'double-cloth,' or more specifically as 'tubular double-cloth.' The weave is often referred to simply as 'tubular weave,' or occasionally, if there is no interchange of warps between faces, as 'hollow' or 'circular' weave. (For discussion of these terms, see pp. 167 f.)

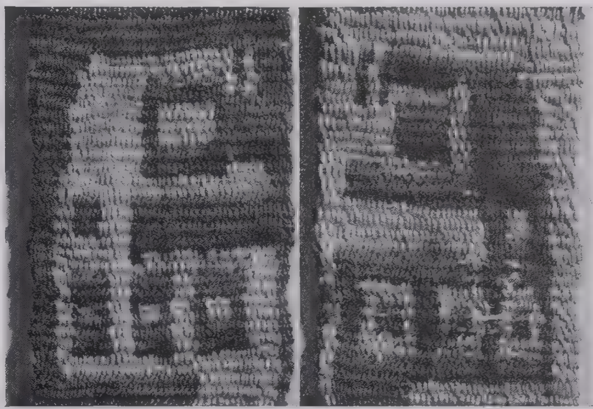

FIG. 264 The two faces of a *warp-faced* 'one-weft double-cloth.' (Detail of red alpaca and natural cotton fragment from Peru; T.M. 91.697.) Warps interchange in pairs.

NOTE: that if a tubular construction is *warp-faced* (as in fig. 264) the *weft* will be hidden, and color patterning can be effected by the interchange, between faces, of the warps of two different-colored sets, or by the use of as many different sets of warp as there are colors desired. In either case warps interlace with the common weft in an unchanging weave order to form an uninterrupted weave structure, although when more than two warp colors are used, each interlaces only in the areas where it is required for the pattern and elsewhere is carried out of sight between the layers, that is, within the 'tube' of the fabric. These fabrics are to a large extent *double-faced* and, since patterning is by interchange of warps alone, the two 'cloths' are interchanged only along horizontal lines. Although each face of the fabric may show a *simple-weave* structure (patterned only by changes of warp color), the fabric itself has a *compound* structure by reason not only of the 'double' method of construction but of the use of more than one set of warps. Many apply the term *tubular* whenever a continuous element serves as weft for two 'layers' of fabric and binds them at their edges.

DOUBLE-WIDTH WEAVE If the weft is continuous but always interweaves twice (over and back) with the warps of one layer before shifting to the other layer, the two layers of the fabric will be joined by the common weft only along one edge and, when removed from the loom, will spread flat and form a single *simple-weave* fabric double the width that was set up in the loom. Thus it is only the construction method that is *double*, not the finished fabric. If the method of construction is known it is entirely reasonable to describe and classify such a fabric as *double-woven*, or as *double-width*, but misleading to refer to it as *double-cloth* (see pp. 167 f.).

DOUBLE-CLOTH WEAVE If one set of warps is interlaced by one set of wefts to form one fabric structure while separate sets of warp and weft are being interlaced to form another, two distinct layers of fabric are produced simultaneously. The two are not only physically discrete but may (although they seldom do) have different weave structures; and inasmuch as each has its own separate sets of warp and weft, the layers can also differ from each other in color and/or texture. Interchanging the two by bringing the elements from the back of the fabric to the face and interlacing them there, while interlacing those from the face on the back (figs. 266 and 268), effects an interchange of colors (or textures) and provides the means whereby two-color patterning (e.g. figs. 265 and 267) of almost any degree of complexity can be produced. The movement of the correlated warp and weft sets from one face to the other also serves to bind the two *simple* structures into one *compound* fabric, making it incontrovertibly

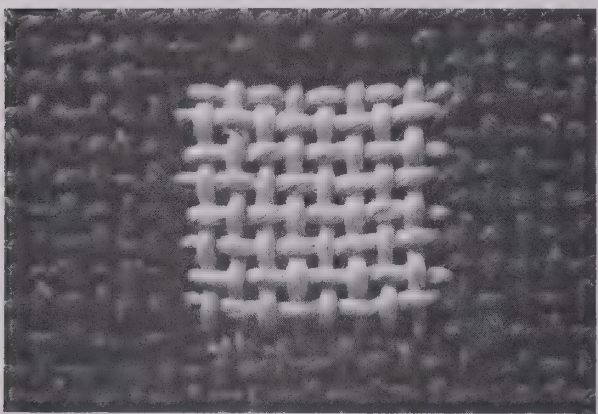

FIG. 265 Detail of one face of a *double-cloth* fabric, showing a square area in which dark warps and matching wefts are replaced by the light warps and their matching wefts from the opposite face. The interchange of warps is single, of wefts in pairs.

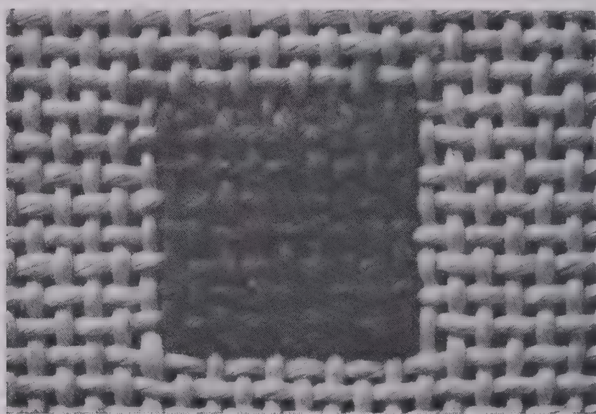

FIG. 267 Opposite face of fig. 265, showing the dark square formed when the light warps and wefts from this face were used to form the light square on the opposite face and were replaced here by the dark ones.

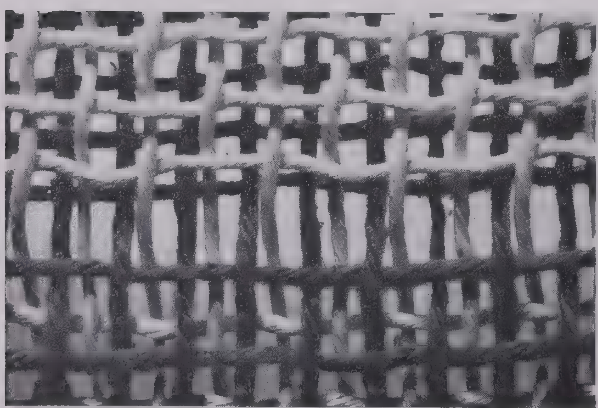

FIG. 266 Diagrammatic construction, showing the one-by-one replacement of dark warps by light (in fig. 265), each interlaced by its matching wefts.

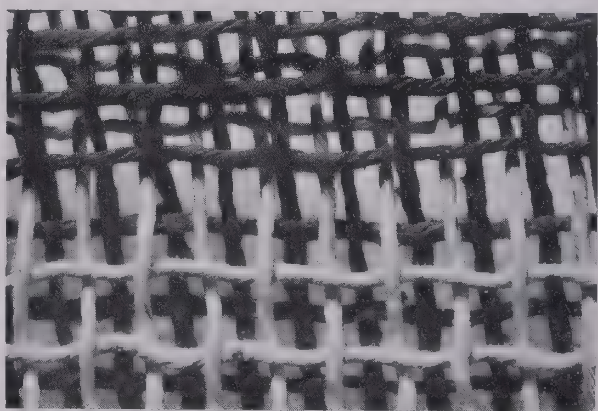

FIG. 268 Opposite face of fig. 266, showing the light warps replaced by the dark. The interchange of warps is single – one and one.

double-cloth. Except at the points of interchange, however, the two 'cloths' are not connected and — unless the pattern areas are extremely minute — they can be pulled slightly apart. The relative spacing of warps and wefts in *double-cloth* tends to be comparatively even ('square count') as in figures 265 and 267; but warps may outnumber wefts — or vice versa — in almost any proportion. Each set of warps is always interwoven with its correlated (and usually matching) set of wefts; pattern areas are identical on the two faces, and usually weave structures as well; the colors (or textures) are reversed in position. *Plain weave* is so much more commonly used for *double-cloth* than any other weave that it is sometimes assumed to be characteristic of the *double-cloth* structure, although *twill* is occasionally used. (For use of the word *cloth* in the term, see pp. 168 f.)

One place where structural detail may vary without entailing any variation of the essential characteristics of the *double-cloth* weave structure is where the warp and weft sets are interchanged between faces. In the *double-cloth* illustrated on the preceding page the warps interchange singly, that is, the warps from one face alternate with those from the other as they exchange places (see figs. 266 and 268), whereas the wefts, as can be seen in figure 265, exchange positions in pairs. This, however, is only one of the possible combinations. (In the examples of ancient Peruvian *double-cloth* shown in figs. 269-274, the exchange of both warps and wefts is consistently in pairs.) Each combination tends to produce certain characteristic differences in the delineation of areas, differences further affected by the tightness and evenness of the weave, by the point in

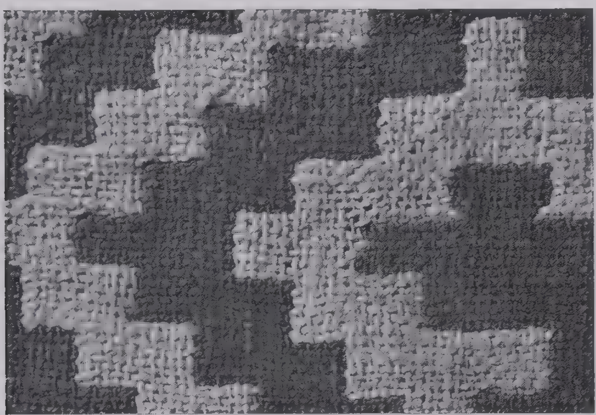

FIG. 269 One face of a *plain-weave double-cloth* with equal warp and weft counts. Detail of a fragment in presumably natural shades of cotton — brown and white — from Peru (T.M. 91.574).

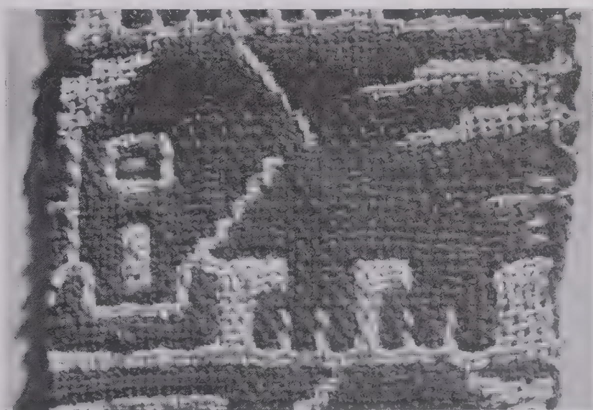

FIG. 271 Completely woven face of a so-called 'incomplete' *double-cloth.* Detail of a fragment of presumably undyed cotton — brown and white — from Peru (T.M. 91.577).

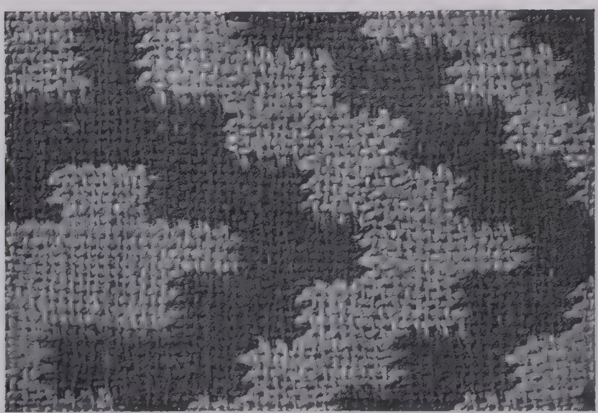

FIG. 270 Opposite face of fig. 269, showing pairing of elements, and jagged lines, at both warp and weft interchanges.

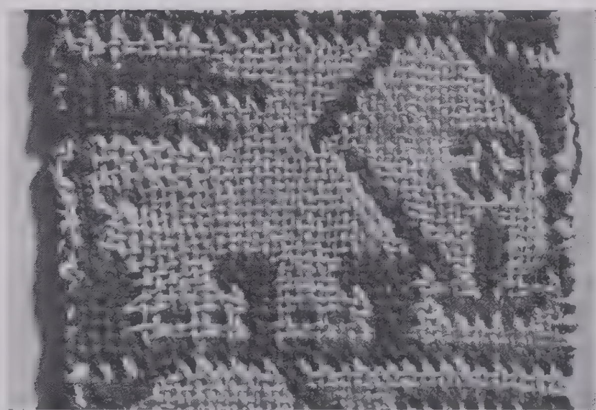

FIG. 272 Opposite face of fig. 271, showing areas where the interweaving of dark wefts with dark warps is 'incomplete.' Both warps and wefts interchange in pairs.

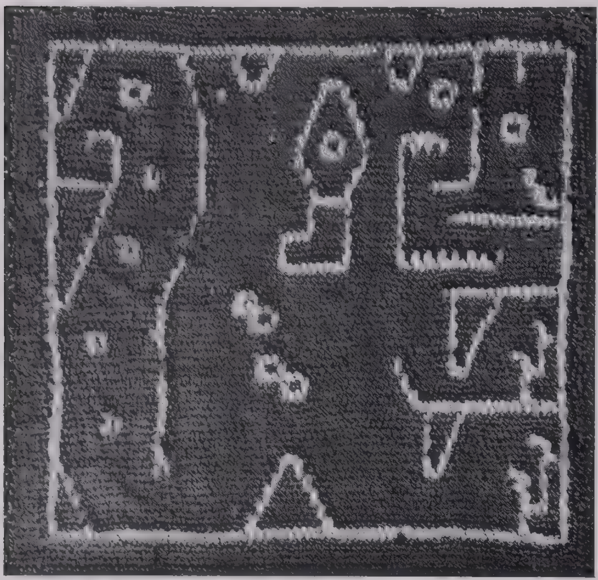

FIG. 273 'Right side' of a linear-patterned 'incomplete' *double-cloth* (with considerably higher warp than weft count) in which some of the patterning is effected by lack of complete interweaving of the light warps by light wefts. Detail of a dark blue alpaca and natural cotton band from Peru (T.M. 91.64).

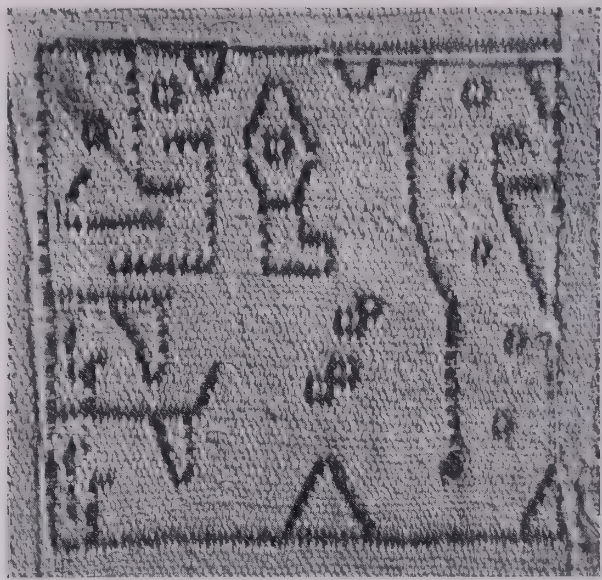

FIG. 274 Opposite face of fig. 273, showing jagged lines of interchange and lack of complete interweaving of dark warps and wefts. Both warps and wefts interchange in pairs.

each weave at which the interchange is made, and to a certain extent by the intervals between interchanges (see fig. 274). The lines of interchange may appear distinctly jagged on one face as compared with the other, and if the jagged interchanges are all on the same face of the fabric, the two faces may appear so *dissimilar* (compare figs. 269 and 270) that one will clearly be the 'right side' and the fabric may well be construed as *two-faced.*

The *double-cloth* structure can, of course, be *supplemented* by extra-warp or extra-weft patterning; and the construction of *extra-warp pile* by the 'double-cloth' method (e.g. *double-woven* velvet, p. 149) might be described as a *variant use* of the structure. Among what could be called *variations* of the structure, we have noted the *double-width* fabrics that, while *double-woven*, cannot be said to be *double-cloth*; and there are also fabric structures which approximate *double-cloth* in either appearance or structure, while lacking certain of the traits that usually characterize it. Among these are the *tubular* fabrics previously discussed which, although *double-woven*, lack the correlation of pairs of warp and weft sets typical of *double-cloth*, and are often identified as 'one-weft double-cloths' (see fig. 264, p. 155). In other fabrics, correlated – and usually matched – pairs of warp and weft sets are interchanged between faces to form pattern without forming two complete fabric structures throughout. In these, each set of warps is interlaced by its own set of wefts in the proper areas on one face of the fabric, while on the opposite face matching warps and wefts sometimes pass from one area to the next wholly without, or only partially, interlacing with each other (see fig. 272). These fabrics are often descriptively designated 'incomplete' or 'partial' *double-cloth* and may be considered *two-faced* if markedly incomplete. (See NOTE on p. 168 for connotation of 'incomplete.')

In still another variety of *double-woven* fabric – sometimes described as 'stitched' (see p. 168) – the two separate cloths are interconnected at intervals either by a fifth set of elements or by the weaving of certain warp (or weft) elements from one fabric structure into the other, rather than by complete interchange of the two. It is to these varieties that the term *double-cloth* as used in the textile industry often refers.

NOTE: that *triple-cloth* is a more complex weave based on the same principles as *double-cloth*. It has a third matching combination of warp and weft sets and a third woven cloth lying between those which form the two

faces of the fabric. However, the use of three sets of warp with matching sets of weft does not necessarily produce a complete *triple-cloth*. In many instances, although each warp set is interlaced only by its own weft set, it is only the face and reverse cloths that are complete (in some, just the face); and warp and weft sets not in use on either face are carried unwoven between the two layers of fabric. Some designate such a fabric 'incomplete triple-cloth' while others prefer to construe and describe it as *double-cloth* with three matched pairs of warp and weft sets. It should be noted, too, that if three sets of warp are woven in three layers by one continuous weft element, the upper two will be joined along one edge, the lower two along the other; and the three will open out into a 'triple-width'— and 'triple-woven' — fabric. Although sometimes designated 'triple-cloth,' this is not the fabric structure usually meant by the term.

B. INTEGRATED WEAVE STRUCTURES

When the structures of two complete weaves are *integrated*, that is, completely interwoven, in one fabric, each set of warps has a companion weft set with which it interweaves in a regular weave order; but, in contradistinction to the more intermittently *interconnected* weaves like *double-cloth*, the weave structures are not separate. Instead, the components of both are interworked throughout, and both faces of the fabric are formed by the *integrated* combination of the two weaves. The fact that the nature of each weave structure is determined by the order in which each set of warps is interlaced by its own set of wefts — although the two weaves are completely interwoven — complicates description of the orders of interlacing of the two weaves unless it is made clear that each is being described as if it were not interwoven with the other.

The ways in which, and the purposes for which, two or more *simple-weave* structures can be combined to form one *integrated compound-weave* fabric have probably never been completely tabulated or classified and cannot be here. It can be stated, however, that added *weaves*, like added *sets of elements*, may serve to 'face,' 'back,' or 'pattern' other weaves; being used to add weight, strength, warmth, decoration, and so on. The weaves that are combined may or may not have the same order of interlacing; in some combinations they are 'complementary,' or co-equal; in others, one acts as a 'ground weave' and is 'supplemented' by the other. A 'supplemental' weave is often used for patterning; and the fabric shown in figures 275 and 276 is an example of such an *integrated* combination of two weaves, one of which (a *2/1 twill*) is used to pattern the other (a *plain weave* with paired warps). It should be noted that in the area where there is patterning, the warps of the supplemental pattern weave are interlaced by (and may be said to 'bind') the correlated pattern wefts — in areas first on one face of the ground weave and then the other — to complete the supplemental weave; whereas beyond the area of patterning there are no supplemental-weave wefts and the supplemental-weave warps interweave in *2/1 twill* order with the wefts of the ground weave which also interlace in *plain-weave* order with their own warps. In this area the supplemental-weave warps become *supplementary warps* interlacing on a ground weave.

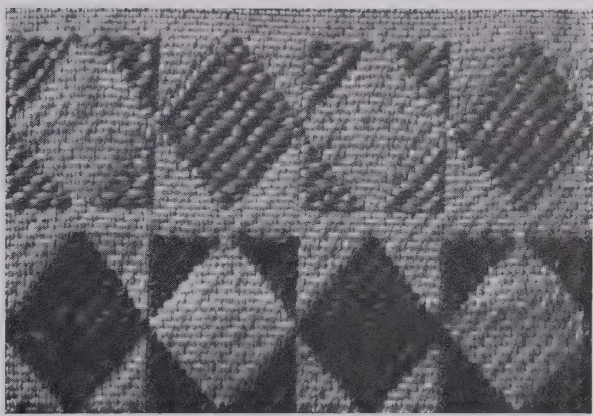

FIG. 275 Detail (x2) of a silk 'scarf'— Spanish or possibly Moroccan, 17th or 18th century (T.M. 84.37) — showing a *2/1 twill weave* used to pattern first one side and then the other of a *plain-weave* ground.

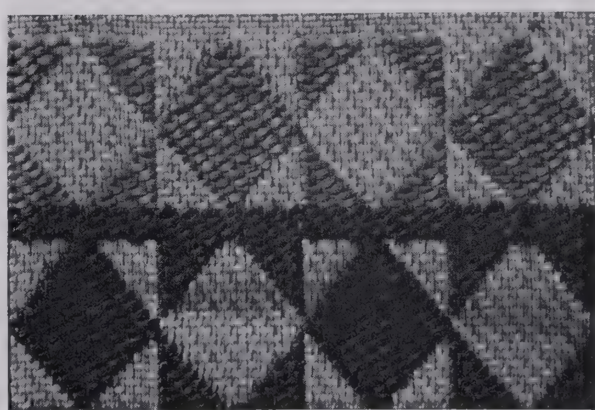

FIG. 276 Opposite face of fig. 275 (turned right to left).

NOTE: that it may be debatable whether or not, if a complete *weave* is called 'supplementary' because it is used to pattern another weave, the two sets of *elements* that compose it are properly called 'supplementary sets.' But inasmuch as the term *supplementary* usually implies a 'non-essential' addition and is used in that sense for separate sets of elements that are added to a ground weave (see p. 140), it seems more applicable, in an *integrated-weave* construction, to a complete *weave* serving as a non-essential addition to a ground weave than to either of the *sets of elements* that compose it, since each set of elements is essential to its own weave structure even though the weave is not essential to the fabric structure. (It is, of course, not only possible but relatively commonplace to find a *ground weave* supplemented by sets of both warp and weft which do not interwork with each other in a regular weave order and would, therefore, even though matched and correlated, be classed as two *supplementary sets of elements*, rather than as components of a *supplemental weave*.)

In many *integrated compound-weave* structures the *simple weaves* that are integrated are *twill* and the structures are sometimes described as 'combined twills.' However, the term *combined twill* (see p. 106) has a rather long history of association with combinations of *twill orders* in the interlacing of one set of warps by one set of wefts, that is, in weave structures that are *simple*, and it is probably better reserved for that particular use. But it is just as well – in order to leave no doubt about the distinction – to specify 'combined twill orders' when referring to the *simple weaves*, and 'integrated twill weaves' when referring to the *compound* ones. In either case, precise description requires a numerical statement of the orders of interlacing involved.

NOTE ON TWILL INTERLACING IN COMPOUND WEAVES

In the foregoing discussion of the various ways in which weaves are compounded, in addition to considering the possibilities of combining *twill weaves* with other weaves, or with other twills, in *integrated compound* structures (v.s.), we have had occasion to note, and often to illustrate, a number of different uses of *twill weaves* or *twill orders* of interlacing, without pointing out each possible use. Inasmuch as *twill* is at once basically simple, almost infinitely variable and adaptable, and very widely used, it may be useful at this point to enumerate the ways in which it can enter into the composition of each of the different general types of *compound weave*.

(1) *Supplementary elements*, discontinuous or continuous, can be interlaced in *twill* order on almost any ground weave. (See fig. 221, p. 141, for an example of discontinuous wefts, and figs. 236 and 237, p. 146, for continuous wefts, in *twill* interlacing on *plain-weave* grounds.)

(2) *Supplementary elements* can be interlaced in orders other than twill on a *twill-woven ground*.

(3) *Supplementary elements* can be interlaced in *twill order* on a *twill-woven ground*. (See figs. 238 and 240, p. 147, for an example of dissimilar twill orders; and fig. 277 for an example of identical twill orders that are structurally *complementary* to each other, although marked qualitative differences between the *complementary sets* may cause one set to be interpreted as *supplementary*.)

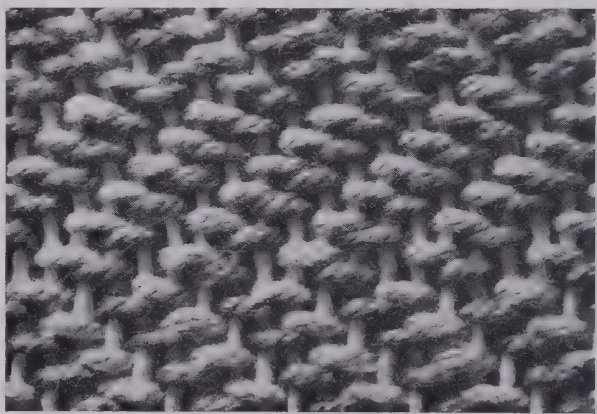

FIG. 277 A *double-faced 2-weft even twill.* Both wefts interlace the warp in *2/2 horizontal herringbone twill.* They are structurally co-equal and hence *complementary*, differing from each other only in color. The two faces of the fabric are *identical*.

NOTE: that if the twill order of a set of elements presumed to be a 'ground' set is the same as that of a second set of elements parallel to it, classification of the two sets (and of the fabric structure) will rest to a certain extent, as in instances previously noted, on a qualitative judgment, since structurally there is no difference in their relationships with the opposite set. If neither of the two parallel sets is either clearly subsidiary to the other or qualitatively related to the opposite set, it is more reasonable to classify the two like sets as *complementary* to each other than to arbitrarily elect to describe one of them as a 'ground' set and the other as *supplementary* to it. In spite of the fact that the interlacing of either of the parallel sets with the opposite one

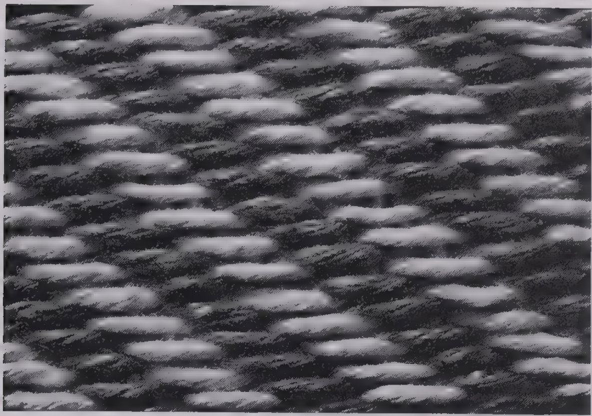

FIG. 278 One face of a *two-faced 2-weft uneven twill.* The two weft sets are structurally co-equal. Both interlace the warp in *4/2 twill,* with the long (4-span) floats of both oriented to this face.

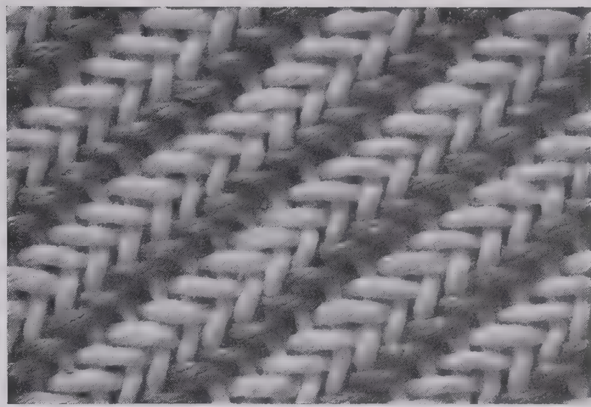

FIG. 279 Opposite face of fig. 278, showing the short (2-span) floats of both weft sets.

would produce a complete weave structure without the other, as long as the two have the same interlacing order they tend to be structurally co-equal; and if they play entirely equivalent parts in the structure of the fabric they can be said to be equally essential to the fabric structure and so to constitute *complementary sets.* Use of the terms *two-weft twill* and *two-warp twill* is suggested as a particularly apt way of denoting this co-equality of two parallel sets of elements both interlacing a third set in the same twill order.

(4) Each of two *complementary sets* of elements can be interlaced with a third set in an *even-twill* order to produce a *double-faced* fabric in which each of the structurally *identical* faces is made up of equal floats of both sets (see fig. 277 for such a *two-weft even twill*).

(5) Each of two *complementary sets* can be interlaced with a third set in an *uneven-twill* order to produce either a *double-faced* fabric structure in which each of the two structurally *identical* faces is made up of the long floats of one of the sets (see figs. 252-255, p. 152), or a *two-faced* fabric structure in which the long floats of both sets are oriented to the same face of the fabric (see figs. 278 and 279). Both can be described as *two-weft uneven twills* (the *two-warp* counterparts are not illustrated), and differentiated as being either *double-faced* or *two-faced.*

(6) Among 'weaves compounded by combining complete weave structures,' in addition to the *integrated* use of *twill weaves* referred to above, it has also been noted that twill can be *double-woven* (see p. 157), that is, two twill fabrics can be woven simultaneously and interconnected as in *plain-weave double-cloth.* Twills that are *double-woven* are sometimes described as 'compound twill,' sometimes, somewhat more adequately, as 'twill double-cloth' or as 'double-woven twill' (see p. 169 for use of the latter terms). But in view of the number of ways in which *twill* interlacing can be used in *compound-weave* structures it is clear that the term *compound twill,* unless amplified, is wholly inadequate as a designation of a specific structure. It cannot be counted on to convey any information beyond the fact that one or more *twill weaves* enter in one way or another into a *compound-weave* structure (see p. 162 for discussion of the term *compound*).

Notes on the Use of Terms

Compound · *Compound weaves* · *Compound weave*

There are two basically different ways in which the word *compound* is used in textile terminology: first, in classificatory terms, for generic reference to a large group of fabric structures, as, for example, in *compound weaves*; and second, to designate one specific weave structure, for example, so-called 'compound weave.' The first – the generic – is by far the most common use of the word *compound* in reference to fabric structures and is the one adhered to in this study. In this sense, many different weave structures can be appropriately described and classified as *compound weaves*, but no one of them could properly be singled out to be designated *compound weave*. Or – to put it another way – while there are many weave structures each of which is 'a' compound weave, no single one of them qualifies as 'the' compound weave. For example, a structure composed of a ground weave with extra-weft patterning would be 'a' *compound weave*, but the term *compound weave* would not serve as a specific designation of that particular structure.

Admittedly even when it is generally agreed that all *woven* fabric structures (i.e. all those composed of interlaced warp and weft elements) can be divided into two general categories of weave structure – *simple weaves* and *compound weaves* – there is still no agreement about where the line that separates the categories should be drawn. In most classifications the line is marked (as it is here, see p. 140) by the presence, or absence, of more than the requisite one-set-each of warp and weft. That is to say, any weave structure made up of two or more sets of warp and/or weft would be classified as a *compound weave*. But there are certain deviations from even this rather widely accepted concept. Sometimes, for example, it is stated only that a *simple weave* becomes *compound* 'by the addition of extra warps, extra wefts, or both'– a definition which, if 'extra' means *supplementary*, seems to omit from the category of weaves classed as *compound* those structures in which *complementary sets* of either warp or weft form the two faces of the weave structure (pp. 150 ff.), and also those composed of two or more distinct fabric structures either *interconnected* (e.g. *double-cloth*, pp. 156 ff.) or *integrated* (see p. 159). On the other hand, in some classifications only so-called 'double-,' 'triple-,' or 'multiple-cloths' are termed *compound* (in others these weaves fall within the general category of *compound weaves* but form a sub-group designated 'multiple fabrics'), and all the other weaves usually classified as *compound* are classed separately as 'backed,' 'faced,' 'figured with extra material,' and so on. In addition, there are some definitions that further specify that extra wefts must go 'the full width of the loom' if the weave in which they are used is to qualify as *compound*, and this of course raises the question of whether when a *simple weave* is patterned by extra wefts it remains a *simple weave* as long as the extra wefts are *discontinuous*.

Fortunately, the term *compound weave* is not often used in the second sense, that is, to designate one specific weave structure, since, when so used, it is usually very difficult to determine exactly what that one specific weave structure is. Often enough the context in which the term is used suggests that it was not really meant to be specific at all, that it was in fact used generically – but carelessly – and that the author could have saved his reader some confusion by the simple addition of the word 'a' to the designation *compound weave*.

There is also a tendency (although not a widespread one) to use the term *compound weave* to designate one certain limited group of weave structures, namely, the *double-faced weaves* that are constructed with *complementary sets* of either warp or weft and only one set of the other element (pp. 150 ff.). But whatever merit this specific use might have is usually negated by inadequate or inconsistent delineation of meaning – a rather crucial fault in view of the relatively wide acceptance of the term *compound weave* in its generic sense. According to some definitions, for example, such a weave is *compound* only if the *complementary sets* are weft sets and the fabric is *weft-faced*; whereas according to others, it is when there is more than one set of warps that a weave is *compound*. In addition, definitions seldom specify interlacing orders, float alignment, or *identity* or *dissimilarity* of faces; and all too often the term is used without being defined or explained at all.

NOTE: that certain somewhat more specific sounding terms like *compound tabby, compound cloth, compound rep* (all discussed on p. 166), *compound twill* (p. 161), and *compound satin*, also fail of real definition since their connotations depend on whether the word *compound* is used generically or specifically, and also on the significance of the accompanying word. All that any of them can be counted on to convey is that some part of what goes to make up a certain *compound-weave* structure is related in either appearance or structure (or both) to the *simple weave* named in the term.

TERMS FOR DIFFERENT SETS OF WARP AND WEFT ELEMENTS:

Binder- · Ground- · Main- · Pile- · Pattern-

The obvious diversity in usage and definition of the term *compound weave* can only lead to confusion; but the confusion seems to stem not only from actual differences in the concept of what constitutes a *compound weave* but also from the way the concept is expressed.

Consider, for example, the sets of warp and weft that compose a *compound weave*. There seems to be no question but that the term *compound weave* – whether used for a large group of weave structures or for a single specific one – always connotes more than one set of warps and/or wefts, each set distinguished from others of its kind by the purpose it serves in the fabric structure. This means that before we can intelligently agree or disagree about definitions of the term *compound weave* or about descriptions of specific *compound-weave* fabrics we need terms with which we can distinguish the different sets of elements by designating their functions. It is the misfortune of the student of textiles that there is no general agreement on such terms and little consistent correlation between the terms for correlative uses of warp and weft.

The term *ground weft*, for example, is often defined as a 'weft which interlaces to form the ground weave in fabrics with more than one weft set.' So used, the term designates clearly the function of one set of weft elements. But the warp with which the *ground weft* interlaces to form a *ground weave* is often called not the *ground warp*, as one might reasonably expect, but the *main warp*.

It is generally conceded, too – and certainly with good reason – that a *warp* which forms the *pile* in a warp-pile fabric should be referred to as the *pile warp*, and the *weft* forming the *pile* in a weft-pile fabric, the *pile weft*. It is further pretty much agreed that the *weft* used to create *weft pattern* in a weft-patterned fabric is a *pattern weft*; but we find that the term *pattern warp* does not always refer to the *warp* whose function in a warp-patterned fabric is analogous to that of the *pattern weft* in a weft-patterned fabric. Instead, the term *pattern warp* is used in some textile terminology to designate certain warps which do not appear on either face of the fabric and which enter into the formation of pattern only by serving to lengthen the floats of the *pattern weft*. Such a warp is more often and more descriptively called an 'inner' or 'interior' warp but at times is also referred to as the *main warp* – although this use of the term *main warp* seems to bear no relation to that noted in the previous paragraph.

The most general – and seemingly most reasonable – concept of a *main* warp or weft is of a principal, primary, or basic one; but the extent of variation in specific applications of the word *main* – particularly when used in reference to *warp* – indicates considerable disparity in individual concepts of the relative importance of different sets of elements in a textile, concepts apparently affected by individual experience with certain loom types, certain fabric types, and/or the literature of certain groups of textiles. The term *main weft*, on the other hand, seems to be used rather more consistently – usually for general, non-technical reference to a basic weft set, that is, to one that is necessary to the fabric structure because it functions regularly throughout the fabric, in contrast to the more limited and *supplementary* functioning of, for example, 'brocading,' or 'pattern' wefts.

Among the terms used to designate differing functions of sets of elements, the word *binder* – in one form or another – is one of those called upon to serve in a number of different ways. It is variously defined as, for example: "the tie for floating weft" (Hooper, 1910, p. 325); "special ends or threads by which two or more textures are held or bound together . . ." (*Callaway Textile Dictionary*, 1947, p. 37); "a plain (tabby) row of weaving laid between each pattern row to keep the cloth firm" (Pritchard, 1954, p. 184); and, in similar vein, "shots of weft . . . made . . . with the purpose of strengthening the fabric" (Zielinski, 1959, p. 10). Of these, the first two

obviously refer to *warp* threads — one to warp threads which 'bind' weft floats, the other to warp threads which 'bind' two fabrics into one. The last two both refer to *weft* used in a *ground weave* — although the Zielinski definition is extended and includes the comment that 'in more elaborate pattern weaves binder occurs not only in weft but in warp as well" (*ibid.*).

When reference is made specifically to *binder* (or *binding*) *warp*, it may be to an 'auxiliary' or 'supplementary' warp used to 'bind' pattern wefts; or, somewhat cryptically, to "a warp additional to the main warp" (C.I.E.T.A., 1959, p. 2 — a vocabulary in which alternative conflicting meanings are given for the term *main warp*). On the other hand, it may refer to the "warp threads producing the foundation of a fabric; interior warp; . . . generally not visible in the finished fabric" (Posselt, 1889, p. 287). *Binder weft*, when defined at all, is usually said to refer either to the wefts which hold "floats or pile-effects in place . . ." (*Callaway Textile Dictionary*, 1947, p. 37) — presumably the wefts of a ground weave — or else to weft which "connects the face and back plies" in double- or multiple-cloths (*Fairchild's Dictionary of Textiles*, 1959, p. 63).

These few examples show something of the variety with which the word *binder* is used. Although often used technically with some arbitrarily assigned meaning, the term — in whatever form of the word — is, comparatively speaking, seldom defined; and when it is used technically without specific definition, one can only guess at the implication. The descriptive usage, on the other hand, of authors who choose to rely more on careful recounting of details than on the use of so-called 'technical terms,' demonstrates that although at present the term *binder* is inadequate as a technical term, it does have common-sense descriptive value. On the assumption then that it is reasonable to expect that a 'binder' will 'bind' something — whether floats of the opposite set of elements or the two fabric entities of a *double-woven* cloth — the term *bind* or *binder* can be used descriptively, rather than technically, in any carefully stated report of a fabric structure, in such a way that there will be little if any uncertainty about what is being bound.

It is important to recognize the fact that often a quite commonplace word, if carefully chosen, will serve to convey an intended meaning without recourse to special definitions or specialized vocabulary. And whenever an everyday word does convey the desired meaning it is bound to be more valuable as a means of communication, in our language or another, than a word used with some arbitrarily assigned technical connotation. It should also be recognized that the more the terms for *warp* and *weft sets* can be correlated (so that the meaning of a term is the same when it is used to designate a certain warp function as when it refers to weft function, and vice versa) the more the danger of misunderstanding or misinterpretation of information can be reduced.

Common sense and logic together would seem to provide the best basis for choosing terms for the different sets of warp and weft elements. Both suggest, for example, that the weft which interlaces with the *ground warp* to make a *ground weave* be called the *ground weft*; that if a *binder warp* binds the pattern weft, the weft that binds a pattern warp could reasonably be called a *binder weft*; and that if a *pattern weft* is one which produces weft pattern, a warp which produces warp pattern in an analogous way could well be called a *pattern warp*. But while logic and common sense provide an excellent criterion for usage, they are not necessarily the best guide to interpretation of someone else's terms which may have been selected on some other basis.

Single-faced · Two-faced · Double-faced

Although all three of these terms are used with various implications of color, finish, and utility, for non-technical description of fabrics, it is in distinguishing between varieties of *compound-weave* structures that they are most important and should be most carefully defined and delimited. The term *single-faced* is perhaps the least controversial of the three — being the least often used to specify structure. In its most common use it has qualitative rather than structural connotations, that is, it indicates a lack of finish on one face of a fabric, or the fact that only one face is meant to be seen (as when the ends of discontinuous wefts have been left hanging, for example, or when continuous ones have been carried from one area to another without regard to the appearance). True, the term *single-faced* is sometimes used to describe *extra-warp* or *extra-weft pattern* structures that are characterized by having the bulk of the extra element on one face — especially patterning like the *extra-weft patterning* illustrated

on page 143 (figs. 228 and 229) in which the *pattern weft* is only visible on one face — but used in this way, the term may be said to have structural connotations only in reference to the patterning; in reference to the fabric structure, the connotation is qualitative. It may seem superfluous to point out that a fabric has two faces and cannot really be structurally *single-faced* — although, as we have noted, some aspect, or added structure, such as patterning (e.g. 'brocading') can be. If its two faces have *identical* structures, a fabric can be classified as structurally *double-faced* (i.e. the structure on one face is duplicated on the other); if its faces are *dissimilar*, as *two-faced* (i.e. each of the two faces has a different structure). But since it is possible for any fabric to have one face less neatly finished than the other or, for one reason or another, obviously not meant to be used as the 'right side,' either *double-faced* or *two-faced* fabrics may on occasion be qualitatively described as 'single-faced.' In other words, describing a fabric as 'single-faced' usually implies a subjective qualitative judgment about the design or fabric concept of the weaver; whereas the terms *two-faced* and *double-faced* can be used to connote objectively verifiable structural characteristics.

Often, however, the meanings of the terms *two-faced* and *double-faced* are not differentiated; and when both are being used, they tend to be interchangeable, although of the two, *double-faced* is usually preferred. The term *two-faced* (occasionally equated with 'two-ply') tends to be employed primarily to explain or to amplify in some way the significance of the term *double-faced*, although it can be — and is, from time to time — put to the more definitive use employed here of differentiating *compound* structures whose faces are structurally *dissimilar* from those whose faces are structurally *identical* — that is, from those sometimes classified, as they are here, as *double-faced*.

The term *double-faced* is widely used both with and without various structural and technical connotations, but with little agreement about its implications. It is seldom clear whether or not any specific structure is meant, let alone the exact nature of it. Used in a very general and completely non-technical sense, the term indicates often that both sides of a fabric are finished and that either side can therefore be used as the 'right side.' In somewhat more specific use, the term sometimes indicates a contrast between faces — either that the two faces of a fabric differ in color and/or texture, or that they have different designs. (It should be noted that the term *two-faced* is also used in all the same ways.) But, when used primarily as a technical term, *double-faced* may denote *dissimilarity* of faces, implying either that a fabric has different weave structures on the two faces, or that different 'qualities of material' and/or colors are produced on the two faces by separate sets of either warp or weft elements, in the same — or in different — weave structures. (And again we find *two-faced* used with the same variety of implications.) At the same time, the term *double-faced* is also used rather frequently to denote *identity* of faces, sometimes referring quite specifically to weaves in which two *complementary sets* of either warp or weft elements interweave with (and often conceal) the elements of a single opposite set in a fabric having two structurally *identical* faces (see pp. 150 ff.) — or one of these weaves may be singled out and designated the 'double-face [sic] weave.' What is more, the term *double-faced* is used at times to designate (as well as to describe) the specific fabric structure better known as *double-cloth* (see p. 156) which is usually characterized by structurally *identical* faces.

Thus the term *double-faced* may in practice be definitely associated with either *dissimilarity* or *identity* of the faces of the fabric, and with either structural or qualitative dissimilarity or identity. But in this volume, as has already been pointed out, the meaning of the term *double-faced* is contrasted with that of *two-faced*. The connotations of both are wholly structural and both refer to *compound-weave* structures — *double-faced*, to compound weaves whose faces are structurally *identical; two-faced*, to those whose faces are structurally *dissimilar*. (For further discussion of the term *double-faced*, see pp. 167 f.)

NOTE: that the terms *double-faced* and *two-faced* are also used at times in reference to *simple* as well as *compound weaves*. So used, they seldom designate structure, are usually indefinite in meaning and reference, and tend to be confusing. We know, for example, that *tapestry weave*, being a form of *plain weave* (a *simple weave* with an *even* order of interlacing) has structurally *identical* faces. But because of the special use to which *plain weave* is put in *tapestry* (i.e. patterning with discontinuous and predominant wefts), pattern- and color-areas are also identical on the two faces and *tapestry-woven* fabrics are often qualitatively described both as

two-faced and as *double-faced*. In this connection the terms do not seem to be differentiated in meaning. Both usually seem to refer to the fact that the fabric is, in the literal sense of the word, *reversible*, that is, that both faces are complete and usable; and there is often an added connotation of identity of pattern and color in the same areas on the two faces. In reference to *tapestry-woven* fabrics then, the terms *double-faced* and *two-faced* seem to be qualitatively descriptive of the fabric itself, without definitive reference to its structure. On the other hand, in reference to certain other *simple weaves* (notably *twills*) the two terms are occasionally used with something of the same structural implications noted when they refer to *compound weaves*, that is, they connote structural *identity* or *dissimilarity* of faces. But in the whole context of *simple weaves*, there is no real need for these two terms (*double-faced* and *two-faced*) to describe structure since, in *simple weaves*, it is the warp-weft order of interlacing that determines the structural *identity* or *dissimilarity* of the faces, and specifying an *even* (or *uneven*) order of interlacing in itself denotes structurally *identical* (or *dissimilar*) faces. (Use of the terms *double-faced tapestry* and *two-faced tapestry* for certain *compound weaves* is discussed below.)

A VARIETY OF TERMS FOR ONE WEAVE STRUCTURE

Various composite terms, although seemingly specific, and used from time to time to designate certain specific weave structures, often fail to be fully definitive because one or more of the terms of which they are composed has a variety of uses and connotations. For example, the simplest form of the *double-faced weaves* constructed with *complementary sets* of either warp or weft (i.e. the form illustrated on pp. 150 and 151 in which the floats of both of the *complementary sets* are in *alternate* alignment) is often referred to specifically as 'compound tabby'—'tabby' presumably indicating the *alternate* alignment of floats and binding (because the interlacing order of 'tabby,' or *plain weave*, is simple alternation) and 'compound' presumably indicating that there is more than one set of either warp or weft elements. There is nothing in the term, however, to show in which direction (warp or weft) there is more than one set, or to indicate that the sets are *complementary* to each other and the fabric faces structurally *identical*. Nor is there anything to suggest that the so-called 'tabby' is actually formed by 3-span floats in alternate alignment.

The term *compound cloth* is also used, apparently in exactly the same way, but by those to whom the word 'cloth' is synonymous with 'tabby' and *plain weave*. Furthermore, the same simple form of *double-faced weave* is frequently designated *double-faced plain weave* — a term which is presumably meant to indicate an alternating alignment of bindings and either structurally *identical* or equally usable faces, but one which neither specifies nor suggests anything further. Still another term, *compound rep*, apparently usually refers to the same weave structure, and while it seems more specific because of the implication of ribbing contributed by the use of the term *rep*, the term *rep* is itself highly controversial and consequently confusing (see pp. 86 f.). While it is presumably used to indicate that a fabric is either *warp-* or *weft-faced* and ribbed in the direction of the concealed element, it may be used to connote one rather than the other. *Compound warp rep* is more specific and apparently usually refers to the *warp-faced* form of so-called 'compound tabby' (although it may, of course, imply that there is ribbing in the warp direction). Again, while it seems fair to assume from the suggested context that references to 'Chinese warp rib' are to the *warp-faced complementary-warp* structure which characterizes many well-known Han dynasty textiles (also referred to as 'warp cloth,' 'Han binding,' 'reversible tabby,' etc.), it is only by inference that that structure is denoted.

In contrast, the term *double-faced tapestry*, which is apparently used at times to specify the *weft-faced complementary-weft* counterpart of these warp structures, seems more definitive, but to be even reasonably sure of what is meant by the term we would have to know if the word *tapestry* is meant to imply weft patterning in the tapestry manner (i.e. with discontinuous wefts covering the warps), and also if the term *double-faced* is used for *compound-weave* structures exclusively (i.e. for structures with more than one set of warps or wefts), as well as whether it is supposed to imply *identical* structures on the two faces. Then when we find the term *two-faced tapestry* used to refer to the same weave and type of fabric (as it often seems to), we have to assume either that *two-faced* and *double-faced* are considered synonymous terms and are not meant to refer to structure, or that *two-faced* describes not a different structure but something different about the appearance of the two faces.

Meanwhile it should be noted that in most of these expressions the weave connotation is provided by some term for the simplest possible weave – plain over-and-under (1/1) interlacing – a weave characterized by the fact that it has no floats. But actually, almost the only place where the 1/1 interlacing of *plain weave* ('tabby') is to be found in *compound-weave* structures (if one disregards the unpatterned ground-weave areas of *extra-warp-* or *extra-weft-patterned plain weave*) is in the discrete layers of *plain-weave double-cloth*. It is true that in so far as *supplementary elements* are interworked with elements of a ground weave, the over-all interlacing order is altered; but the nature and interlacing order of an undeniable ground weave is usually stated as if the non-essential *supplementary elements* were not involved, and the binding of the *supplementary elements* by elements of the ground weave is usually described as if unrelated. Similarly, when the weaves that make up an *integrated compound weave* are described, the order of interlacing of one pair of correlated warp and weft sets is arbitrarily divorced from that of the other pair, or pairs, and is stated as if there were no other weave integrated with it. So it is important to keep in mind that although weaves with *complementary sets* of elements cannot be similarly broken down into separate weave structures, when terms like *plain weave, tabby, rep*, and *tapestry* are used in composite designations of *compound weaves*, they are just as likely to refer to *alternation* in the points of binding and the alignment of floats as to actual 1/1 interlacing of warp and weft.

Double-faced · Double weave · Double-woven · Double-cloth · Tubular weave · Double-width

It is important at this point, as it so often is when comparing and contrasting the meanings and uses of terms, to distinguish the descriptive significance of a certain word (e.g. *double*) in a composite term, from the meaning and the use of the whole term which is sometimes designative. Although, as has been noted, the term *double-faced* is sometimes used as a designative term for a specific weave, it has another more practical and rather widely accepted use, namely, to describe either a fabric or a fabric structure in terms of a certain two-fold (i.e. *double*) characteristic – specifically, duplication of structure on the two faces. Similarly, in the term *double weave*, the word *double* refers to some two-fold characteristic of weave structure (usually to the use of two complete weaves), and in the term *double-woven* to a two-fold process. The term *double-cloth*, however, has proved valuable not only as a term which is descriptive of a fabric marked by two-fold qualities but also as one with which to designate a quite specific type of two-fold weave structure.

It is often hard to be sure in any given instance whether a composite term containing the word *double* is being used primarily for the general descriptive implications of that word, or whether it is intended to refer more specifically to groups of weaves characterized by certain kinds of 'doubleness.' We have discussed one descriptive but structurally definitive use of the term *double-faced* – as contrasted with *two-faced* – for certain fabric structures which are faced on one side by the elements of one set of warp or weft and on the other side by those of a *complementary set* in an *identical* structure (see pp. 150 ff.). But it should also be noted that the term *double weave* is sometimes used to designate specific weave structures, and that when so used it almost always refers either to this same *double-faced* structure or else to what is more commonly designated *double-cloth* (see pp. 156 ff.). When used in the latter sense, *double weave* may be meant to indicate the double process of weaving, and thus to refer to *double-woven* structures. If so, it would refer to fabrics of 'tubular' (p. 155) or 'double-width' (p. 156) construction as well as to any complete *double-cloth* – whether or not additional sets of elements are employed for interconnections, embellishment, or construction of pile.

But *double weave, double-woven*, and *double-faced* all seem to function best as general classificatory terms and are best reserved for that function – whereas the quite specific structural connotations of the term *double-cloth* seem well enough established to be worth preserving. Thus the specific weave structure called *double-cloth* can be said to be usually *double-faced*, always *double-woven*, and could be considered a *double weave* to the extent that any weave composed of two complete weave structures could. But neither a *double-faced weave*, a *double-woven* fabric structure, nor a *double weave* is necessarily a *double-cloth*, nor is it, for that matter, any specific weave structure.

Of all these terms, if their uses are differentiated, *double weave* would be the most general and would refer to combinations of complete weave structures in which each of the two structures has its own sets of warp and weft and can be either *interconnected* in any one of several possible ways (see pp. 155 ff.) or *integrated* (see p. 159) with the other.

Use of the term *double-woven* would be slightly less general. Being a term of process rather than of structure, it would refer to the process of simultaneously weaving two complete but distinct and separable fabric structures. The word *double* describes the weaving process only, and the double quality is not necessarily retained in the finished fabric (note, for example, *double-width* fabrics, p. 156, and *double-woven* pile fabrics, p. 149).

The term *double-faced* can be used with more specific connotations. A *double-faced weave* is not necessarily a *double weave*, nor is it necessarily *double-woven*; it may be a weave in which each of the two faces (*identical* in structure) is produced by a set of elements *complementary* to the set composing the other face. (The term is, in fact, sometimes used to specify one or another particular form of this weave, even though this renders the term useless for the wider, more important application.)

The term *double-cloth*, on the other hand, is usually quite specific. It refers to a *double weave* that is *double-woven*, that is, a *double weave* in which two complete and discrete weave structures are woven simultaneously – specifically, a fabric in which the two separate weave structures are *interconnected* only where they exchange places, where some elements of one pass briefly to and from the other, or where both are bound together by still another set of elements. (Either of the last two types of interconnection of fabric structures may be what is meant when a *double-cloth* is described as 'stitched,' see p. 158.) Although *double-cloth* is usually *double-faced*, there are often slight structural differences (as noted on pp. 157 f.) – and there can be different weaves – on the two faces.

NOTE: that the fabric structure descriptively designated 'incomplete' or 'partial' *double-cloth* is 'double' in the sense of having two correlated pairs of warp and weft sets (i.e. 'double' sets of warp and weft) but – in the areas that are 'incomplete'– is not *double-woven*. It is the lack of complete interweaving of one or the other of the warp-and-weft sets that leads to the *double-cloth* being called 'incomplete' (see p. 158).

Although the relationship of what is called *tubular weave* (p. 155) to *double-cloth* and to other *double-woven* and *double-faced* weaves is subject to differences of interpretation, it is rather generally agreed that a *tubular weave* is one which, although *double-woven* and often *double-faced*, is not, strictly speaking, a *double-cloth* (although sometimes called that) – since it is the use of a single weft for both 'cloths,' instead of one for each face and for each warp set, which makes the cloth *tubular*. In fact, the expression 'one-weft double-cloth' is often used in preference to the term *tubular weave* to designate a 'tubular' fabric – especially when the fabric is patterned by the interchange of warps from one face to the other (see fig. 264, p. 155) and hence is not literally and obviously tube-like. The expression 'tubular double-cloth' is also commonly used but apparently to no particular advantage inasmuch as the term *tubular weave* usually seems adequate when the tube-like characteristic is maintained in the fabric, while when the warps are interchanged (as the two fabrics are in true *double-cloth*) the expression 'one-weft double-cloth' seems more precisely descriptive. A term like *hollow weave* seems clearly meant to refer to the simple tube-like form of the weave and is a good descriptive word for the finished fabric structure; while *circular weave*, also suggesting the hollow or tubular form, is more descriptive of the passage of the single weft in the process of weaving than of the structure.

The term *double-width* describes a fabric characteristic in terms of the way the fabric is produced. In describing the width of the finished fabric, the term indicates that the fabric was *double-woven*, but does not signify anything about the structure of the weave itself. The process is *double*, as is the width of the finished fabric, but the weave structure itself is not. That is to say, a *double-width* fabric is actually *double-woven*; but once it is woven, the word *double* applies only to the finished width of the fabric in relation to its manufacture. (Use of the term *circular weave* instead of *tubular* seems to have led to occasional use of the rather curious expression, 'semi-circular weave,' to describe a *double-width* fabric structure.)

Double-cloth · *Double twill* · *Double satin*

Most *double-cloth* consists of two layers of *plain-weave* fabric; but when the two layers are woven in

twill or *satin* instead of in *plain weave*, the fabric structure is often not identified as *double-cloth* at all but is designated *double twill* or *double satin*. This nomenclature reflects a definite and limiting concept of the significance of the word *cloth* in the term *double-cloth*. For it is only when the word *cloth* is interpreted as tantamount to a statement that the weave is *plain weave* that the terms *twill double-cloth* and *satin double-cloth* will be discarded as self-contradictory, and the terms *double twill* and *double satin* substituted. But the terms *double twill* and *double satin* are something less than definitive inasmuch as both are also used (impractical as it may seem) for weave structures that are *double-faced* but not *double-woven*, when both faces are *twill* (see p. 152) or *satin*. One way in which the term *double-woven* can be particularly useful is in thus differentiating between various *compound-weave* structures. It can be used, for example, to distinguish a 'twill double-cloth' (by describing it as '*double-woven* twill') from a '*double-faced* twill' (which could be presumed to have structurally *identical* twill faces, as on p. 152, but not two discrete twill structures), as well as from what is sometimes described as a 'two-weft twill' (which is often, as illustrated on p. 147, *two-faced*).

Backed · Faced

Use of the term *backed* to designate fabrics characterized by the use of a *supplementary set* of warp or weft elements for that specific purpose is more typical of the vocabulary of the textile industry than of hand weavers and textile historians. It is not that the structure of the fabrics so described is either recent or restricted in use, but rather because the use of certain weave structures for the specific purpose of adding weight, strength, or thickness to a fabric at minimum cost and without affecting its surface appearance has increased with the industrialization of fabric production and become somewhat standardized. In the textile industry generally, the most common way of 'backing' a fabric seems to be by interweaving a *supplementary set* of either warp or weft in such a way that the surface appearance of the fabric is affected very little if at all; and such a use of *supplementary elements* seems to be what is referred to when the term *backed* is used to describe a fabric or a fabric structure ('warp-backed' or 'weft-backed' according to the direction of the *supplementary set*). It should, however, be noted that such a 'backed' fabric may also be described as being 'faced' (for example, in the definition of "Faced Cloth — Fabrics which have a separate set of warp or weft on the wrong side," Harmuth, 1915, p. 62). But although sometimes carrying special implications and associations, *backed* and *faced*, as fabric terms, tend to have more qualitative connotations than structural. In fact, in technical usage, their sole connotation of structure often seems to be the use of a *supplementary set* of elements (see pp. 145 ff.).

A confusing inconsistency of usage is exhibited when a *supplementary element* used for 'backing' is referred to as a 'ground' element, and also when 'pile' fabrics like velvet and velveteen are described as 'backed fabrics' and the *ground weave* is construed as 'backing' instead of the pile structure being construed as 'facing.' But on the general principle that an element used for 'backing' is an element that supplements a weave on whichever face is to serve as the wrong side of the fabric, the term *backing* can be used with implications only of structure and orientation — instead of necessarily inferior material — for any *supplementary-element* structure used on the 'back' of an essential weave. So used the term can be correlated with its converse; that is, the use of a comparable structure oriented to the right side of a fabric would be construed as 'facing.' Both terms would refer to the primary spatial relationship (i.e. the orientation) of a *supplementary* structure to a *ground*, regardless of whether or not the *supplementary* structure appears on only one face (a matter determined at least in part by the relative sizes and the spacing of the elements of the various sets).

NOTE: that the terms *backing* and *facing* may also refer to *complete weave structures* used to *supplement* other weave structures on the 'back' or the 'face' of either *integrated* or *interconnected compound weaves* (q.q.v.); although such fabrics are probably more commonly described in non-technical terms as 'double faced' or 'two faced' fabrics.

Overlaid · Underlaid · Laid-in

Overlaid and *underlaid* are two terms occasionally employed, especially in the vocabulary of hand-weaving, to describe the use of *supplementary elements* for 'facing' and 'backing' respectively. The use of the word *laid* is always more appropriate to descriptions of weft manipulation — specifically of

wefts being 'laid-in' certain sheds — than of warp; and we find that the terms *laid-in* (see p. 141), *overlaid*, and *underlaid* are all customarily used to designate various functions or uses of *supplementary wefts*. Thus *extra-weft* structures may be described as 'laid-in' (or 'inlaid') when the *supplementary wefts* lie in the same sheds as the ground-weave wefts; as 'overlaid' when floats of *supplementary weft* are on the 'right side' of the structure (serving as 'facing'); and as 'underlaid' when they serve on the 'wrong side' as 'backing.' (Occasionally, analogous *extra-warp* structures are similarly identified.)

NOTE: that when the term *onlay* is used to specify a kind of *appliqué* (see p. 251), it is synonymous with 'overlaid' but when used to designate one way of using *supplementary wefts*, it is as a synonym for 'inlay'— that is, it is usually used to refer to *supplementary wefts* that are laid in the ground-weave sheds.

If, without alteration of the total weave structure, an *extra-weft-float* structure is used now on one face of a ground weave, now on the other, terms like *turned* and *counterchanged* can be used, as they are in reference to unsupplemented (i.e. *simple*) weaves, to describe "the fact that the weave structure is literally 'turned over' and used now one face up, now the other" (p. 132). The textural (and sometimes color) contrast created by 'counterchanging' a *supplementary* structure can be used for 'area patterning' in the same way that contrast between the weave faces of *uneven simple float weaves* is used in *damask*, *twill damask*, or any other 'turned' *float weave* (see pp. 101, 112, and 118). It is on this principle that some of the *extra-weft* fabric structures described as 'damassé' are based, as is the simpler block-pattern type of weave structure, characteristic of certain early American hand-woven coverlets, known as the 'Summer and Winter weave'— which is basically a 'counterchanged' *extra-weft-float weave* (see fig. 235, p. 146).

NOTE: that the so-called 'Summer and Winter weave' is often said to have 'originated' or 'been invented' in America; also that according to one author it is 'not found in Europe,' while according to another it is 'of Scandinavian origin.' Perhaps because 'Summer and Winter' is a hand-weaving term, the exact nature of the weave it refers to and the range of variation it embraces are seldom stated but must usually be deduced from discussions of the weave as a 'threading technique,' and from 'threading' and 'treadling' directions. Such a statement as Mrs. Atwater's to the effect that "in structure a summer and winter fabric consists of a plain tabby foundation overlaid and underlaid by a pattern weft that is bound into the fabric by every fourth warp-thread" (Atwater, 1933, p. 207) is more indicative than some, of the essential nature of a Summer and Winter fabric, but is not readily reconciled with her statement (typical of many) that "the 'summer and winter' weave . . . appears to be a method of weaving peculiar to America" (*ibid.*, p. 205). The name *Summer and Winter* (presumably suggested by the characteristic contrast of light and dark areas on both faces of the coverlets and related fabrics) may well have originated in America, as may the association of this particular type of weave structure with special fabric qualities and uses, and possibly even its adaptation to a particular kind of heddle-controlled block patterning; but neither the basic weave structure itself nor the particular way of using it to pattern can be attributed to any specific time or place of either origin or exclusive use.

'Summer and Winter weave' is not a technical term to be used for structural identification or classification but a name for a particular way of threading, weaving, and patterning a particular kind of fabric. It should not be used, as it too often is, to describe or designate the structure of any fabric that happens to be patterned by reciprocal areas of contrasted light and dark. Being a hand-weaving term, it is best used in the hand-weaving context, and even then only in reference to that basically two-color, heddle-controlled, block-pattern fabric type to which it apparently originally applied.

Patterning:

Warp- · *Extra-warp* · *Warp-float*

Weft- · *Extra-weft* · *Weft-float*

References to *warp* or *weft patterning* are usually very general and apparently seldom meant to specify, or even to imply, one kind of pattern structure rather than another. Obviously the structure of any pattern formed by warp elements can be described generically as 'warp pattern,' if formed by weft elements, as 'weft pattern.' The expressions *extra-warp* and *extra-weft patterning* are manifestly more specific, since they state that the patterning referred to is produced by elements that are *supplementary* to a basic or ground weave. They do not, however, specify either the interlacing order of the *supplementary elements*, or any other structural characteristics of the patterning — which may be *laid-in* (i.e. interlaced in unison with the corresponding elements of

the ground weave), *floated*, or used to form *pile*. The terms *warp-float* and *weft-float pattern*, on the other hand, name the pattern element and one major structural characteristic of the patterning, but not the relationship of the pattern structure to the fabric structure as a whole; that is, *warp-float patterning* may or may not be *extra-warp patterning* – and *extra-warp patterning* may or may not be *warp-float patterning*. For example, pattern created by counterchanging (between faces) the elements of *complementary sets* in a *double-faced* weave structure (see pp. 150 ff.) is either *warp* or *weft patterning* (depending on whether the *complementary sets* are warp or weft); it is, of necessity, either *warp-* or *weft-float patterning*; but it is not *extra-warp* or *extra-weft patterning*. *Laid-in patterning*, on the other hand, is *extra-weft* (or may be *extra-warp*) *patterning* but it is not in any sense *float patterning* (unless the ground weave in which it is 'laid' happens to be a *float weave*), even though there may be floats on the reverse between pattern areas (see p. 143).

NOTE: that any structural patterning formed by the regular warps or wefts of a *simple weave* is necessarily *float patterning*; but since *warp floats* on one face are inevitably countered, on the opposite face, by *weft floats*, and vice versa (no matter what the variation in visual effect), the patterning cannot be accurately identified as either *warp-float* or *weft-float patterning*. If, for example, only weft floats lie on that face of a *simple weave* that is unquestionably meant to serve as the 'right side' of the fabric – or if the wefts so far outnumber the warps that the warp floats do not appear as floats – the term *weft-float patterned* would describe the one 'face' of the fabric but it would not be an accurate designation of structure. Analogously, a *warp-faced twill* might seem to be an example of a *simple weave* that is *warp-float patterned*; but structurally the *warp floats* are countered by *weft floats* and it is only the ratio of warp- to weft-count (per unit of measurement) that disguises the fact. The patterning of the fabric may appear to be effected solely by *warp floats* but to describe it as *warp-float patterning* invites misinterpretation.

Brocade · Brocaded · Brocading · Brocatelle

Although the word *brocade* is usually used to identify a type of fabric characterized by certain qualities, rather than to specify a weave structure, it is one of the least consistently (but most widely) used terms in the whole field of patterned and figured fabrics; and while there are certain general areas of agreement, there are extensive areas of disagreement about its exact connotations. It is primarily a fabric name, but has come to be used in reference to a great variety of patterned fabrics as if it designated weave structure.

In many contexts the word *brocade* is used generically for richly patterned silk fabrics usually characterized by the use of gold or silver thread. In fact in some usage, the use of gold or silver thread is the definitive trait that justifies classifying a fabric as *brocade*. But usage differs widely, and as a 'trade' name, *brocade* often seems to connote nothing more specific about a fabric than that its patterning is 'woven in' and presumably relatively elaborate, while in the nomenclature of hand-weaving the word has tended to acquire specific but diverse structural connotations.

Many feel that the word is so thoroughly drained of meaning by much casual and ill-considered use that all forms of it should be avoided in technical description. However, in some discussions, definitions, and uses, a practical distinction is made between *brocade* as a fabric name and the verb forms *to brocade*, *brocaded*, and *brocading* – which presumably can be used to connote more or less specific structural characteristics. If this distinction is made, the perennial controversy about what particular aggregation of qualities of design ('floral,' 'figural,' 'geometric,' 'localized,' 'sectional,' 'raised,' etc.) and material (silk, gold, silver, etc.) must be present if a specific fabric is to be identified as a 'brocade,' can be divorced from the controversy about the structural nature of the patterning; and the then more limited problem of the specific structural connotations of the terms *brocaded* and *brocading* can perhaps be solved to the satisfaction of most of those who require structurally definitive terms.

The term *brocading*, for example, seems to have certain rather widely accepted structural connotations. It is quite generally agreed that it refers to a way of *patterning*, specifically, patterning by means of *supplementary elements*, and usually even more specifically, patterning by means of *supplementary wefts*. But there is considerable controversy about whether or not the structural connotations of *brocading* include the use of continuous (selvedge-to-selvedge) pattern wefts, as well as the use of discontinuous ones. It is widely contended that a *pattern*

weft is properly termed a *brocading weft* only when it is worked back and forth in its own pattern area, is not carried from one pattern area to another, and never passes from one selvedge of the fabric to the other – which seems to be a relatively sound basis on which to circumscribe the meaning and use of the term *brocading*.

NOTE: that since *brocading* is primarily a term of weft function and one that usually connotes localized use of discontinuous wefts, the term *warp brocading* seems incongruous to say the least. However, when there is localized warp pattern which reproduces similar weft pattern in a fabric, and the weft pattern is constructed with discontinuous wefts and described as *brocading*, the significance of the analogy between the warp and weft structures, even though the warp patterning is necessarily constructed with continuous warps (possibly cut away between pattern areas), may warrant the description 'warp brocading.'

Small individual weft carriers, usually called 'bobbins' or 'spools,' are frequently used for patterning with *discontinuous supplementary wefts*, a fact reflected in the Italian words *spolinato* (apparently the equivalent of the English word *brocading* in the sense suggested above) and *spolino* (like the French *espolin*) for the spool or bobbin used to carry the *brocading weft*. (The use in English of the term *brocading shuttle* is hard to justify and seems unnecessarily confusing.) Association of the discontinuous-weft technique with the use of spools or bobbins is also reflected in the expression 'bobbin weave' which is sometimes used to distinguish fabrics patterned by means of discontinuous wefts from those in which pattern wefts are 'thrown' (i.e. carried in a shuttle that is thrown) from selvedge to selvedge (occasionally described as 'shuttle weaves').

In French, the term *lancé* (literally 'thrown,' 'cast,' or 'shot') seems to be used effectively to differentiate fabrics patterned by selvedge-to-selvedge extra-weft action from those which are patterned by discontinuous-weft action and are described as *broché*. But there seems to be no English equivalent in fabric terminology for *lancé* nor any English word commonly used to make the same distinction – which may explain some of the current unwillingness to limit the applicability of the term *brocaded*, without justifying the failure to adopt either the French word *lancé* or some English equivalent as a converse for the term *brocaded*.

NOTE: that although in French the term *broché* is apparently used in contradistinction to the term *lancé* to distinguish extra-weft patterning by means of discontinuous ('brocading' or 'bobbin') wefts from that produced by continuous ('selvedge-to-selvedge,' 'thrown,' or 'shuttle') wefts, it is often used in English (written with or without the accent) to refer to the weaving of isolated or discrete areas or units of pattern with continuous pattern elements which float on the reverse of the fabric wherever not in use on the face. This use seems very close to (if not identical with) the French use of *lancé*, with which – in French – *broché* is contrasted. At the same time, *lancé* is very little used in English although it would seem a far more suitable and useful term to borrow than the misused term *broché* (for which the English *brocaded* serves as a reasonably adequate equivalent).

The idea of some sort of association with 'embroidery' pervades the assembled definitions of the term *brocading*. Although the relationship, sometimes attributed (with doubtful justification) to a common word origin, is stated in many different ways and with varying degrees of emphasis, it is at least referred to in nearly all definitions and in many discussions of the term and the technique. It is frequently stated, for example, that *brocading* gives the 'effect of embroidery,' that it is often and easily 'confused with embroidery,' that it 'originally' may have 'included embroidery,' and also that *brocading* is an 'embroidery weave.' The localized patterning usually associated with *brocading* in itself suggests embroidery, and the freedom with which it can be added to a ground is undoubtedly one reason for the frequent references to the 'effect of embroidery' as a characteristic of *brocading*. The fact of possible confusion with embroidery, too, is undeniable, since if a decorative element is consistently aligned with the weft of the background fabric and never pierces an element, it may be quite impossible to determine whether the decorative element is a *brocading weft* that was incorporated during the weaving process or an *embroidery* thread worked into the completed fabric. The prevalence of the sense of a fundamental relationship between *embroidery* and *brocading* as methods of fabric embellishment is reflected in the use of the term *embroidery weave* as an explanatory equivalent of the term *brocading*. It gives further evidence that the term *brocading* may be most useful as a term for designating structure if it is used to refer only to extra-weft patterning in which the pattern wefts are discontinuous and to specifically dif-

ferentiate such patterning from all extra-weft patterning (localized or not) in which pattern wefts are carried from selvedge to selvedge. In order to designate the specific structure or particular order-of-interlacing of the patterning, however, other terms must be added, as in *twill brocading*, for example, or *laid-in brocading*.

NOTE: that the term *overshot brocading* is sometimes used to designate the *two-faced* use of pattern wefts in which they float on one face whenever not floating on the opposite one (producing negative pattern or pattern in reverse) even when it is selvedge-to-selvedge patterning which might better be described as 'overshot patterning' (see p. 142).

The term *brocatelle* (*brocatel*) is related to the term *brocade*. The origin of *brocatelle* is usually said to be the diminutive form of the Italian equivalent of the English word *brocade* (both coming from the Spanish *brocado*), and it is often defined in terms of *brocade* (e.g. 'imitation brocade,' or 'a kind of brocade') but with the implication of inferiority. Like the term *brocade, brocatelle* designates a fabric type rather than a weave structure. It has connotations of varied fiber content (usually including the use of linen) and of various design and fabric characteristics; but it is only occasionally that there are any structural connotations attributed to it. *Brocatelle* is sometimes described as a fabric 'similar in appearance to brocaded fabrics but dissimilar in construction,' and one of its most frequently mentioned characteristics is pattern that is 'raised' or 'in relief.' The use of *satin weave* in *brocatelle* is often mentioned though seldom very explicitly (e.g. 'raised satin figure,' 'effect of satin in relief,' 'satin ties in figure') and an indeterminate relationship to what is called *lampas* is occasionally suggested – *brocatelle* being sometimes described as 'a form of lampas' and *lampas* as 'a weave similar to brocatelle.' Clearly *brocatelle* is not a term with which to designate or describe fabric structure.

Pile · Nap · Tufts · Tufted

The terms *nap* and *pile* are sometimes used synonymously, particularly in casual non-technical descriptions, and the word *tufts* is apparently occasionally used, in defining *pile*, to distinguish 'cut' from 'uncut' loops. Often, however, in a pile-fabric context, the word *tufts* (or *tufted*) refers either to untwisted and usually natural-length bunches of fiber (especially wool 'flocks') secured in a fabric structure (as described on p. 148), or to the 'hooked-rug' or 'tufted bedspread' type of *accessory* structure (see p. 245).

The definition of the word *pile* on page 148 is a composite definition embodying the common features of over fifty different ones drawn from a wide variety of sources in several languages and from the 19th as well as the 20th century. There is comparatively little difference of opinion, particularly in the more recent definitions, about what constitutes 'pile' or about the distinction between the meanings of *pile* and *nap*: *pile* referring to a kind of structure in a third dimension anticipated (in the arrangement of floats, for example), if not actually produced, in the process of weaving; *nap* referring to a kind of surface produced by subjecting a fabric to certain 'finishing' processes. *Pile*, as already noted, can be constructed either by *interlacing* or by *wrapping* (see pp. 221 ff.) a *supplementary element* in such a way as to form loops (which can be cut or left uncut); by cutting floats of a *supplementary element* woven in for that purpose; or by cutting apart a *double-cloth* specially woven with a *supplementary* pile element which serves both cloths. *Nap* is usually described as being produced by 'raising' some of the fibers from the surface of a fabric (i.e. loosening them from the body of the material) by one or another mechanical process such as 'teaseling' (so-called from the burs used in an early form of the process); but the word *nap* once referred as well to a naturally rough surface (on cloth) that required shearing and smoothing. Thus while the process of 'napping' (i.e. producing a 'nap') may be described as a finishing process, the word *nap* – particularly in older usage – may refer to a kind of surface which itself requires finishing. In either case the term *nap* almost invariably refers to a surface quality rather than to a structure – the chief exception being found in the occasional synonymous use of the terms *pile* and *nap* or in the occasional failure to distinguish between them. Evidence that such usage is probably casual rather than well-considered – that it stems from a failure to distinguish between the two terms rather than from a positive concept of equivalence – is suggested by the fact that the word *nap* is never substituted for the word *pile* in the various terms for specific kinds of pile such as 'cut-pile,' 'knotted-pile,' 'pile-on-pile,' and so on. Further evidence is found

in the admonitions, repeated in definitions of both *nap* and *pile*, that one term is 'not to be confused with' the other. It seems generally agreed that the meanings of these terms can and should be differentiated.

TERMS FOR PILE STRUCTURES:

Structural · Non-structural · Accessory

Woven · 'Knotted' · Cut-float · Needlework · Hooked

There are relatively few specific technical terms commonly used to differentiate various 'pile' structures; and many of the terms that are used are literal enough to be readily understood and correctly interpreted. *Structural pile*, for example, is any pile constructed as pile concurrently with the fabric – that is, any pile not produced by some post-constructive process, such as cutting the floats of a woven fabric (and producing what could be termed 'cut-float pile'). It is obvious that *structural pile* can be either 'woven-pile' or 'knotted-pile'— that is, either an *interlaced* pile structure in which the sole interworking of the pile element (always *supplementary*, but either warp or weft) with the ground weave is rectilinear *interlacing* (see p. 148); or *extra-weft pile-wrapping* (pp. 221 ff.) in which the pile element is a *wrapping weft* which wraps the ground warp (although it may, on occasion, *interlace* it as well, see fig. 349, p. 224).

Any *woven-pile* structure that is dependent for its existence as pile on a post-weaving procedure could properly be considered *non-structural*. Included in this category would be all 'cut-float pile' such as that in *weft-pile* fabrics like 'corduroy' and 'velveteen' (q.v.), as well as in such *warp-pile* (or 'velvet') fabrics as are woven as supplementary-float weaves. The classification of a *double-woven* pile fabric (see p. 149) is necessarily equivocal, since, although constructed as pile in a third dimension in relation to the ground weave, it is nevertheless dependent on subsequent cutting.

Pile added to a finished fabric is *accessory pile* (see pp. 245 and 246), whether made, like embroidery, with sewing element and eyed needle (which could be described as 'embroidery' or 'needlework' pile) or 'hooked' through the fabric in loops or tufts, as in 'hooked rugs,' et cetera.

Looped-pile · Cut-pile · Pile-on-pile · Double-pile

The terms *looped-pile* and *uncut-pile* seem self-explanatory, both referring to *structural pile* in which the loops have not been cut; and the term *cut-pile* clearly refers to pile having cut ends instead of loops. But *cut-pile* is also sometimes referred to as 'velvet-pile' in contradistinction to 'terry-pile'— which is another, less common, term for 'looped-' or 'uncut-pile.' *Cut-float pile* is always *cut-pile*; *woven-* or *'knotted-' pile* may or may not be. The expression 'cut-and-uncut-pile' is also self-explanatory, but the French term *ciselé* (literally, engraved or chased, but often used in reference to velvet as if equivalent to 'cut-and-uncut') is not. It sometimes specifically distinguishes 'cut-and-uncut' velvet in which the cut-pile is longer than the uncut; but it is applicable only to velvet, not to pile weaves generally.

The expression 'pile-on-pile' is used to describe 'relief' or 'high and low' pile, that is, pile having different heights in different areas.

The term *double-pile*, although often misleadingly used to designate pile fabrics that have been *double-woven* (see p. 149) and occasionally used as a synonym for 'pile-on-pile,' usually describes a fabric having pile on both faces (sometimes alternatively described as 'double-knotted'). Such a fabric could be more definitively described as either *double-faced* or *two-faced* (depending on the *identity* or *dissimilarity* of the pile structure on the two faces) 'woven-pile' or 'knotted-pile' (depending on the structure of the pile).

NOTE: that in the term *voided velvet* (which customarily refers to velvet in which there is raised pile only in certain areas, the pile element being woven into the flat weave of the ground in the remainder), the word *voided* is presumably used, as in heraldry, to mean "pierced through to show the field" (*Century Dictionary*, 1914, v. 9, p. 6781). But in so far as it suggests some post-weaving process by which pile is eliminated from certain areas, rather than the fact that, like the 'area' type of supplementary-element patterning (p. 141), the *pile element* is only used for raised pile in the required areas, the term *voided velvet* is misleading. Furthermore, there is no equivalent term for other fabrics in which pile weaves are used in the same fashion. They are presumably construed, as *velvet* could well be, as examples of a variant use of pile (to pattern a ground weave, for example) rather than as a variant kind of pile fabric.

NAMES OF 'PILE FABRICS':

Velvet · Velveteen · Plush · Terry · Fustian · Corduroy

Some of the names of 'pile fabrics' have come to be used as if they had specific structural connotations. The word *velvet*, for example, is often used to designate *extra-warp woven-pile* structures as distinguished from *extra-weft woven-pile*, which may be designated *velveteen*. However, the distinction between the terms *velvet* and *velveteen* is comparable to that between *satin* and *sateen* (see pp. 137 f.) in that it may be a structural differentiation, a fiber differentiation, or a combination of the two (although the usefulness of fiber as a basis for differentiating between *velvet* and *velveteen* is reduced by the fact that the pile and the ground weave may be of different fibers.)

As a technical term, *velvet* may refer to use of the *extra-warp woven-pile* structure, and *velveteen* to use of the analogous *extra-weft* structure; *velvet* may refer to the use of silk, and *velveteen* to cotton; or — and this is perhaps the most common usage — *velvet* may imply the use of both a *warp-pile* structure and silk, *velveteen*, *weft-pile* and cotton. If either term is qualified, the nature of the qualification will suggest the intended meaning; that is, it would be reasonable to assume that 'cotton velvet' would refer to *warp-pile* made of cotton, and 'silk velveteen' to *weft-pile* of silk. But on this basis, 'weft velvet' would seem to refer necessarily to silk *weft-pile* (since 'weft velvet' could hardly refer to a *warp-pile* and the use of the word *velvet* must be assumed to have some connotation); yet this cannot be taken for granted since it is always possible that *velvet* may have been used, without any fiber connotation, as a general technical term for *woven-pile*, with the word *weft* specifying which one of two possible kinds. The expression 'warp velveteen' would be somewhat less equivocal since, with the word *velveteen* quite clearly denoting some variant or imitation of *velvet*, 'warp velveteen' would seem to necessarily imply cotton *warp-pile*. But with so much left to the vagaries of interpretation, none of these expressions can be sufficiently definitive to be of technical value; and once more we note that if the name of a fabric type must be used for a fabric structure some confusion can be avoided by appending the term *weave* to show that the implications of the term are wholly structural. *Velvet weave* can be properly differentiated from *velveteen weave* only on the basis of structure — presumably on the basis of whether warp or weft is used to form the pile. (The fact that mechanically woven *weft-pile* is *cut-float* pile, whereas mechanically woven *warp-pile* can be analogous but is normally *structural pile*, does not seem to have been noted as a possible basis for differentiating *velveteen* from *velvet*.) But the *warp-pile* versus *weft-pile* distinction is not explicit unless both terms, *velvet weave* and *velveteen weave*, are being used; and we often find *velvet* used as a technical term (denoting *extra-warp pile*) by many who use the term *velveteen* only as a fabric name and use *weft velvet* to distinguish *extra-weft pile*. Others, more explicit in their technical use of the term *velvet*, always specify *warp velvet* or *weft velvet* — presumably without fiber connotation, but often with a specific statement of fiber content.

The word *plush* usually serves as the name of a fabric type — distinguished from *velvet* by having greater length of pile (often explicitly stated as 'more than 1/7 inch'); and, with analogous connotation, *plush velveteen* refers to the same increased length of pile in *velveteen*, when presumably *velveteen* refers to a cotton fabric with cut weft-float pile. But there are instances of the use of the term *plush* as a general synonym for *velvet*; others of the use of the term *plush weave* as a generic term for "that method of weaving which combines a pile with a ground warp" (Murphy, 1911, v. 8, p. 161); and still others in which *plush* refers specifically to *warp-pile* fabrics in which the pile is mohair.

The term *terry* (presumably from the French *tirer*) has, according to the *Shorter Oxford English Dictionary* (1955), been in use since the late 18th century. (When it is stated, e.g. Linton, 1954, p. 671, that "the principle of Terry weaving originated in France in 1841" the reference must be to mechanization of the process of terry weaving since the principles on which *terry* is constructed are the long-established principles of all *extra-warp loop-pile*.) The consensus is that *terry* refers to *uncut*, or *looped*, *warp-pile*, usually cotton; and that *terry cloth* can have such looped pile on either or both faces. The term *terry velvet* is used to refer to *velvet* (i.e. silk warp-pile) when the loops are uncut, but at the same time it should be noted that the term *terry pile* is used in contradistinction to *velvet pile* to differentiate pile with uncut loops from that characterized by cut loops.

The word *fustian*, a fabric name probably dating back to the 11th or 12th century, has little current use except as a technical term associated with the mechanics of cutting weft-floats to form pile (note, for example, references like those to "fustian cutting for the development of a pile surface," and to "a fustian knife" by which "the floats of weft are severed," Nisbet, 1919, pp. 160, 161). The word *fustian* seems always to have referred to some heavy workaday fabric. Originally, apparently, the fabric had a linen warp and cotton weft; later wool was used and sometimes the fabric was heavily 'napped.' Eventually the term came to be associated more specifically with 'heavily wefted' materials, especially those with weft-floats that could be cut to produce pile, and now refers chiefly to *corduroys* and *velveteens*, although it may still include fabrics woven in the same way but with the floats uncut.

Many definitions of the word *corduroy* attest to a relationship between the fabric it refers to and *fustian*. The term *fustian* has less specific connotation than *corduroy*, not that it serves as a generic term for a type of fabric of which *corduroy* could be considered a variety, but because in the course of its long period of use it has referred to a number of different specific fabrics. In contrast, there seems to be little or no variation in the meaning ascribed to the term *corduroy*; it refers quite consistently to cotton *weft-pile* fabrics ribbed in the warp direction, the pile produced by cutting the vertically aligned floats of a *supplementary* (pile) *weft*. There is occasional indication (particularly in 19th century usage) that *corduroy* can be cut or uncut, but the common contemporary concept is clearly of a cotton cut-pile fabric, vertically ribbed.

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PART TWO

Classification of the Structures of Fabrics

I Felted Fibers

II Interworked Elements

- A. Single Element
- B. Two Single Elements
- C. One Set of Elements
- D. Two or More Sets of Elements
  - 1. Interlacing warps and wefts
  - 2. Interacting elements
    (*see below*)

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2. INTERACTING ELEMENTS

a. Crossing and re-crossing

- 1). Crossed-warp weaves
  - a.) Simple gauze weaves
    - Types of variation:
      - Direction of warp shift
      - Extent of warp shift
  - b.) Complex gauze weaves
  - Variant uses of gauze weaves:
    - Patterning
  - Note on 'diverted' supplementary warps
- 2). Transposed-warp weaves

NOTES ON THE USE OF TERMS

Cross • *Transpose* • *Deflect* • *Divert*
Gauze • *Gauze weave*
Gauze • *Leno* • *Fancy gauze*

SOURCES OF INFORMATION

2. Interacting Elements

In the foregoing discussion of *simple-* and *compound-weave* structures, we have been concerned only with the simplest kind of spatial relationship between interworking elements — namely, planar, or flat, rectilinear *interlacing* — and only with the interlacing of essentially parallel elements with others more or less at right angles to them. Although we have found the possibilities of variation, within these limitations, to be seemingly unlimited in extent, we have, at the same time, found them restricted for all practical purposes to two major kinds — variation in the order of the interlacing and in its complexity (the latter resulting from the number of additional *sets of elements* and the nature of the combinations of interlacing involved).

There are, however, other large groups of fabric structures that are characterized by certain alterations of the spatial relationship between elements. The basic relationships between elements of the same set are altered by *interaction* when they *cross* and *re-cross* or *spiral* (i.e. *twine*) about each other; while the spatial relationship of the elements of one set to those of the other is altered when the elements of one set *wrap* or *knot* about those of the other. In either case, variation and elaboration is to be found more in the nature and complexity of the *interaction* than in the order of interworking (which is often co-incidental). Furthermore, there is relatively little use made of additional sets of elements, and practically none of *integration* of two or more complete weave structures.

In fabric structures in which there is *interaction* between elements of the same set, the elements of that set no longer retain their essentially parallel positions. They either: a) *cross* and *re-cross* other elements; or b) *spiral*, or *twine*, about them. Of these, the first is structurally a simpler *interaction* (although not necessarily simpler to effect), and in practice is restricted to *warp* action. It requires a warp that is secured at both ends; and the fact that warps keep returning to their original order suggests that the *crossed-warp* techniques may have been developed on the heddled loom, although the actual crossing of the warps may or may not be heddle-controlled. *Twining*, on the other hand, is adaptable to either *warp* or *weft* action, does not require a fixed warp, and is seldom associated with the use of heddles.

A. CROSSING AND RE-CROSSING

Structurally, then, the simplest deviation from the planar and rectilinear characteristics of flat *interlacing* is made when certain warp elements are *crossed* over (or under) adjacent warp elements, retained in their out-of-line positions by the interlacing of weft elements, and immediately or eventually *re-crossed* to their original order. In this particular *interaction* between *warp elements* we recognize the distinguishing characteristic of *gauze weave* (one of the most widely used and familiar of the weave structures that are characterized by deviation of warp elements from their parallel positions) as well as the mark of the less familiar, usually decorative, structures which may be described as *transposed-warp weaves.*

1. CROSSED-WARP WEAVES

In *gauze* and related *crossed-warp weaves*, there is no *twining, wrapping*, or *knotting* of elements about one another. The interworking relationship of one element to another (either of the same or of the opposite set) is simply over and under; hence it is basically an *interlacing* relationship. But the *interlacing* is not rectilinear; it is seldom at right angles; and only the weft elements are essentially parallel to each other. Neither is it simply an *interlacing* of the elements of one set with those of the other. It is an interworking sequence of warp over warp and under weft, or vice versa, and any enumeration of the interworking order of the warps must take both into account.

The word *gauze* has certain qualitative connotations. Presumably the tendency to associate the word with a general concept of lightness, sheerness, or openwork, in a fabric, was originally due to the presence of those qualities in fabrics called by that name (see pp. 189 f.); and *plain gauze weaves* (e.g. fig. 282) have long been widely used — and may well have developed — as a way of producing a sheer, openwork, yet firm, fabric structure on the heddled loom (although that is neither its sole use nor its sole means of production). The relative simplicity of the interworking of warp and weft elements — only one step removed in simplicity from *interlacing* — makes many of the *gauze* and *diverted-extra-warp* weaves adaptable not only to the heddled loom but to mechanically controlled patterning.

NOTE: that the *interaction* of warps in *gauze weaving* is often described as a 'turning' or 'twisting' of two warps about one another. The words are probably suggested by the process rather than by the finished structure; neither is accurate unless qualified, and may be misleading even then. 'Half-turn,' for example, is more nearly descriptive (than is 'turning' or 'twisting') of the action of certain warps in relation to adjacent ones, an action which is sometimes felt to be more than a simple crossing, since the warps that cross over other warps are also held under the wefts. But to many, 'half-turn' suggests continuation of the turning movement instead of the automatic reversal of it (the 're-turning' of the 'half-turn,' the *re-crossing* of the warps which had *crossed* each other) that repeatedly returns the warps to their original order and gives the *gauze-weave* structure one of its most distinctive characteristics.

A. SIMPLE GAUZE WEAVES

If each alternate warp thread is drawn sidewise under an adjacent one before being raised to form the shed, insertion of a weft in the shed will secure the warps in their new and reversed positions (fig. 280) and what may be called a *gauze cross* will be formed. Then if the warps are allowed to cross back to their original positions before the next weft passage, another cross will be formed and the basis for *gauze weaving* established (fig. 281). If this *crossing* and *re-crossing* is repeated with the same warps always passing in the same direction over the same adjacent ones, a structure is produced that can be identified as *plain* (1/1) *gauze weave* (see fig. 282). It will be noted that the same two warps cross and re-cross each other throughout, and the interworking, like that of *plain weave*, is all one element at a time (1/1), that is, one warp crosses and re-crosses one other warp, and wefts interlace the warps over-1-under-1. At no time does any element, warp or weft, cross over or under more than one other element — either of its own or the opposite set — and the two faces of the structure are *identical*. In the basic forms of *gauze weave* adjacent warps always shift in opposite directions, one to the right, the next to the left. (The concept of two warp sets, i.e. differentiation between 'fixed' and 'crossing' warps, is discussed on p. 190.) In *plain* (1/1) *gauze weave* (fig. 282) each alternate warp shifts first to the right, over (or under) its companion warp, then back to the left, to its original position, while the intervening warps are doing the opposite. It should be noted, too, that in any *simple gauze weave*, as well as in some variations and elaborations, warps that pass over other warps pass under wefts, and vice versa.*

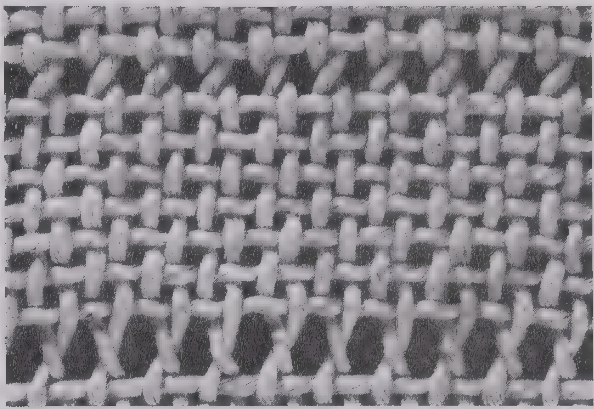

FIG. 280 *Gauze cross*: *crossing* of alternate warps over intervening ones (and *re-crossing* after an uneven number of shots of weft in *plain weave*).

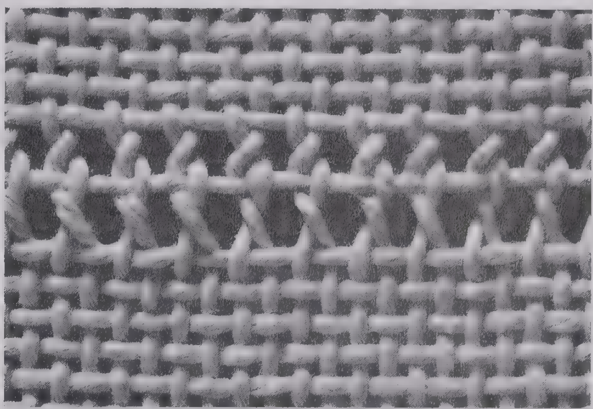

FIG. 281 Basic structure of *gauze weave*: *crossing* of alternate warps over intervening ones, and *re-crossing* after a single weft shot to secure the cross.

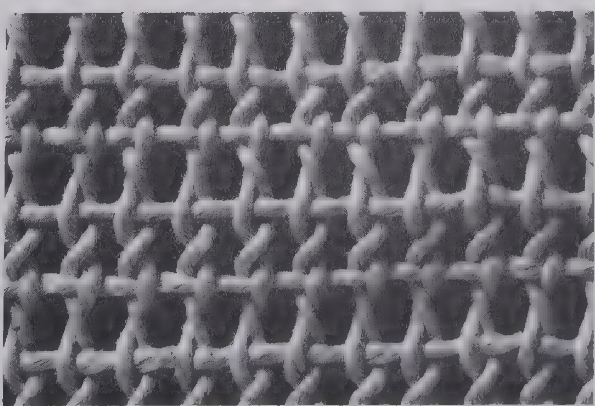

FIG. 282 *Plain* (1/1) *gauze weave*. Warps and wefts both interwork 1/1.

NOTE: that the implications of any notation of the interworking order of warp elements is necessarily somewhat different for *gauze weaves* than for rectilinear *interlacing*. Statement of the weft-interlacing order is the same – a statement of the passage of each weft element over and under successive warp elements. But notation of the sequence of over-and-under interworkings of the warp elements is composite. It enumerates the successive crossings of certain warps over (or under) certain other warps and under (or over) the next weft. In the *plain* (1/1) *gauze weave* (fig. 282) wefts interlace warps in 1/1 order and each alternate warp interworks over one warp and under the weft; the intervening ones, under one warp and over the weft. In the variation shown in figure 284, the warp order is not varied but the variation of the direction of warp shift alters the weft order to 2/2. In that shown in figure 285, the weft order is not varied but the warp order is over two warps and under the weft for warps transposed in one direction, under two warps and over the weft for the alternate ones, transposed in the other direction. Thus if it is understood that warps interwork with other warps as well as with wefts, the warp order of *plain alternating gauze weave* (fig. 285) can be stated as 2/1, the weft order as 1/1. As in rectilinear *interlacing*, of course, when two or more elements act as a unit throughout the weave structure, any statement of the interworking order is in terms of units rather than elements. In figure 283 the interworking order of warps and wefts is the same as in figure 282 – the difference lies in the fact that in figure 283 each warp unit is composed of two warp elements.

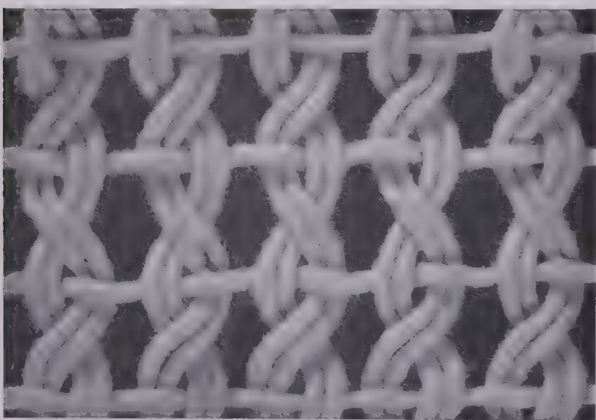

FIG. 283 *Plain* (1/1) *gauze weave* with *paired warps.*

TYPES OF VARIATION:

We have seen that in *gauze weaves* the interworking of elements involves not only over-and-under *interlacing* of weft with warp elements but also the interworking of warp elements with other warps; and that this interworking of warps with other warps involves a lateral shift of certain ones in relation to others. Consequently simple modifications of *plain gauze weave* are produced by variations in either the direction of the warp shift or its extent, and may involve variation of the weft interlacing order as well, although the *identity* of the faces is not altered.

DIRECTION OF WARP SHIFT In one simple modification of *plain gauze weave* (comparatively limited in use) the *direction* of the warp shift is altered but not the *extent;* that is to say, the standard warp order of over-one-warp, under-one-weft (and vice versa) is unchanged, but the direction of the shift is reversed (i.e. countered) in alternate pairs. The inner warps of adjacent warp pairs separate to cross one to the right, the other to the left, over its companion warp. This countering in adjacent warp pairs causes the wefts that secure the warps to interlace them over-2-under-2 (fig. 284).

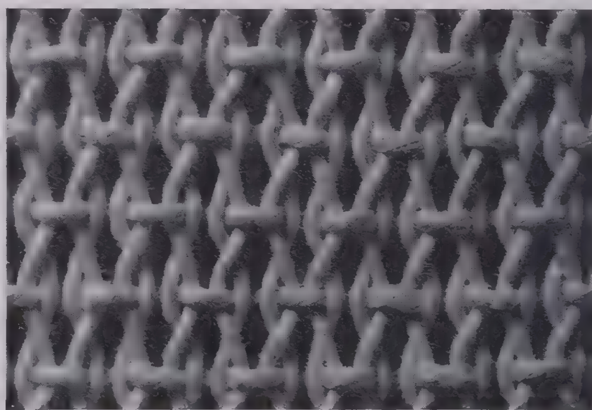

FIG. 284 Directional variation of *plain 1/1 gauze weave* effected by reversing (i.e. countering) the direction of warp shift in alternate pairs. The warps shift, and interwork, 1/1; the wefts interlace the warps over-2-under-2.

NOTE: that the patterning possibilities of this crossing of warps alternately toward and away from each other is exploited when the color or textural qualities of the crossing warps are in contrast to those they cross over; and the same principle is the basis for much so-called 'transposed-warp patterning'– particularly that produced by *supplementary warps* (see p. 187).

EXTENT OF WARP SHIFT In the most important of the primary modifications of *plain gauze weave*, the transposition of warps – the warp shift – is a

shift of alternate warps to the right (or left) over two, instead of one, of the warps that are shifting in the opposite direction. As in *plain* (1/1) *gauze weave*, alternate warps shift in one direction, the intervening ones in the opposite direction. But in this variation each of the warps shifting in one direction crosses over two of those shifting in the opposite direction, and in the return of all warps to their original positions – after having been secured in their out-of-line positions by a passage of weft – the same warps cross back over the ones they crossed in the first shift. That is, the warps no longer work consistently in pairs; instead, the warps that compose a pair separate after crossing each other, each to cross (or be crossed by) a warp from one of the adjacent pairs so that the components of one pair of warps interwork with component warps from each of the pairs adjacent to it. As a result, the alignment of the points at which warps are secured in their shifting positions by passages of weft, instead of being *vertical* as in *plain* (1/1) *gauze weave* (figs. 282 and 283), is *alternating* (fig. 285).

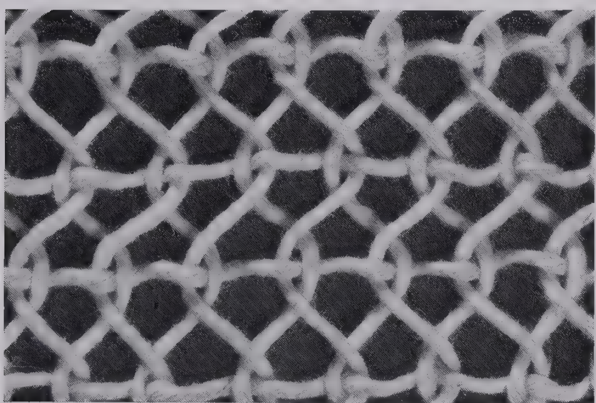

FIG. 285 *Simple alternating gauze weave:* warps interwork 2/1, wefts 1/1.

NOTE: that inasmuch as it is a basic and distinguishing characteristic of *gauze-weave* structures that warps are shifted laterally out of their originally parallel positions and then back again and are secured in each position by the interlacing of the weft, wefts that interlace warp elements without being involved in the maintenance of the warp positions may well be considered *supplementary* (i.e. non-essential) to the *gauze-weave* structure. For example, in what is basically the *alternating-gauze-weave* structure there may be passages of weft that simply interlace the warp in 1/1 order at points intermediate between those where the warps change direction (see fig. 286). If these wefts were to be considered part of the basic *gauze* structure, a literal statement of the interworking order of the warps would fail to show either that the actual *gauze-weave* structure is that in figure 285, or that removal of the wefts that simply interlace the warps would leave the basic *gauze weave* intact. (It is just such an insertion of extra wefts between the regular holding wefts in *plain gauze weave* that produces a fabric structure often described as *half-gauze*, a term discussed on pp. 190 f.). It should be noted, however, that these intermediate wefts as well as the *gauze wefts* conform to the *gauze-weave* formula in always passing over the warps that cross over other warps and vice versa.

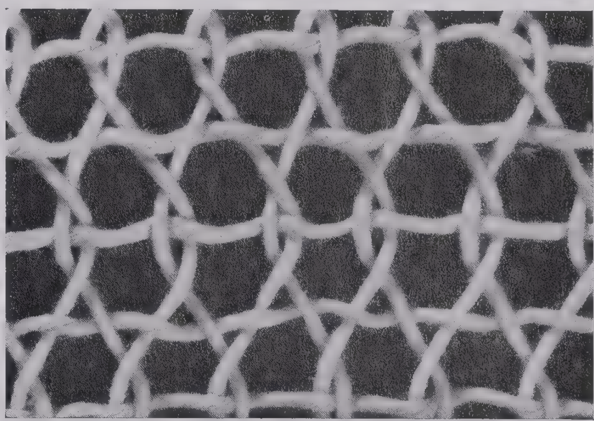

FIG. 286 *Alternating gauze weave* with intermediate non-holding wefts interlacing 1/1.

Although *gauze weaves* are best (and sometimes exclusively) known as 'openwork' weaves, and are used chiefly for the sheerness and laciness they can produce in a fabric without sacrifice of firmness, many gauze structures have other uses. Although the qualitative characteristics of *gauze weaves* are nearly as dependent on the relative qualities and quantities of the elements of the different sets as are those of *interlaced-weave* structures, the *crossing* of the warps between weft passages tends to produce visible interstices and to eliminate the possibility that the weft can be made to conceal the warps. However, the closer the warps are set (and the farther apart the wefts) the less open the structure will be (see fig. 287), and we find that the over-2 interworking of warps in *alternating gauze weave* (fig. 285) gives the structure a flexibility that makes it possible to weave it partially or even wholly *warp-faced*. In fact the weave is often used to create relatively solid or opaque areas with which to pattern some other *gauze weave* that is inherently more open in structure.

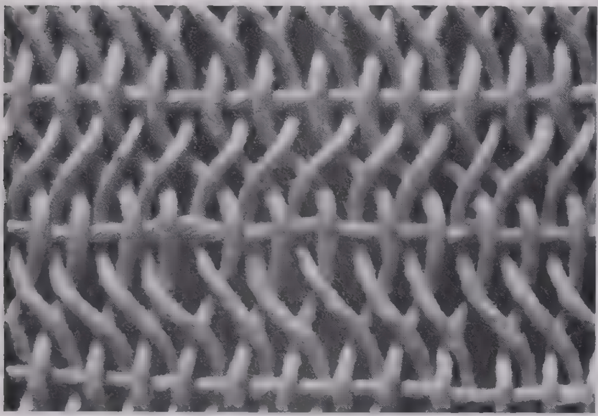

FIG. 287 *Simple alternating gauze weave* with higher warp than weft count.

B. COMPLEX GAUZE WEAVES

Simple gauze weaves are characterized by repeated movement of the warps out of, and back to, their original order on each two successive weft passages, and by unvaried orders of both warp-interworking and weft-interlacing. The *gauze-weave* structure becomes *complex* when there is variation in the order and sequence in which adjacent warps interwork with other warps, and consequent variation in the interlacing order of successive wefts. For example, in *plain* (1/1) *gauze weave* (fig. 282) two adjacent warps consistently cross and re-cross each other; one weft passage holds them in their out-of-line positions, the next holds them once more in their original order; and the weave, which is composed solely of repetitions of these movements and relationships, is a *simple gauze weave*, one which may (like 1/1 *interlacing*) be said to be complete on two warps and two wefts. The *alternating gauze weave* (figs. 285 and 287) is also complete on two wefts but not on two warps. Each of two adjacent warps is involved not only with the other but also with one warp from an adjacent pair; that is, four warps (out of six successive ones) are involved in the requisite lateral shift. But since all warps are back in their original order at every second weft passage, and since both warp-interworking and weft-interlacing orders are constant throughout, this weave too is a *simple gauze weave*.

Of the *gauze weaves* classified as *complex*, one of the most elementary can be seen in figure 288. Although the structure may appear to be simply an alternation of *plain* (1/1) *gauze weave* (fig. 282, p. 181) with the same weave with *paired warps* (fig. 283, p. 182), this appearance is due partly to the vertical alignment, and it will be seen that in the combination, the warp-interworking and the weft-interlacing are both varied. The warps work in groups of four instead of two, and the four warps have two different numerical orders of interworking other warps. In one numerical order, the shift is over (or under) two warps, in the other over (or under) one. The weft order is 2/2 in one passage, 1/1 in the next, and the structure could be said to be complete on two wefts and four warps. The faces are structurally *identical*.

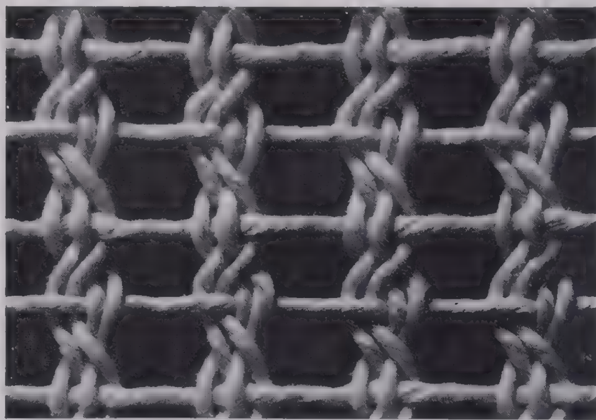

FIG. 288 A *complex gauze weave* with vertically aligned groups of four interworking warps. There are two numerical orders of warp-interworking and two of weft-interlacing.

When the alignment is *alternating* (as in fig. 289) instead of *vertical*, the weft order is unchanged (it remains 2/2 in one passage, 1/1 in the next) but it takes four weft passages to complete the structure, and there is variety not only in the interworking order of successive warps but in their grouping and in the interworking sequence of each. At each 2/2 weft interlacing, warps are grouped in fours, and at each 1/1 interlacing, in twos; but after each 1/1 interlacing, the groups-of-two diverge and each combines with an adjacent group-of-two in a new group-of-four at the next 2/2 interlacing. Thus the alignment of the points at which wefts interlace warps in 2/2 order is *alternating*. Conforming to the usual *gauze* formula, alternate warps cross over other warps and under the wefts, intervening warps, vice versa; but of the two (in any one group-of-four) that cross over other warps, one will cross and re-cross two warps and then cross and re-cross one, the other will reverse the sequence, crossing and re-crossing

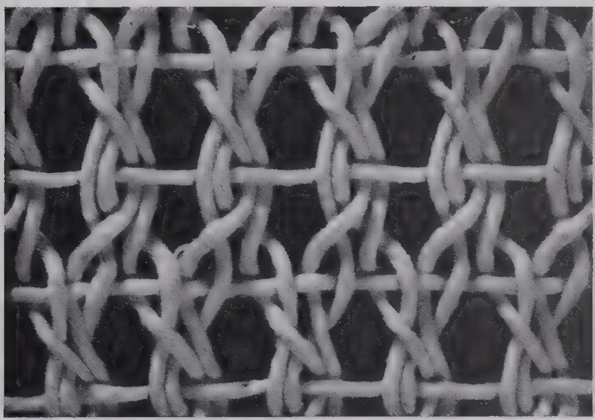

FIG. 289 A *complex alternating gauze-weave* structure with two numerical orders of weft interlacing and two different orders and sequences of warp interworking.

first a single warp, then two. The sequences of warps that interwork under, instead of over, other warps are analogous, and the faces of the structure are *identical.*

This *alternating* structure is the basis for many *complex gauze weaves*, and although there are numerous ways of expanding and developing it, one much-used kind of modification should be especially noted. It is exemplified when one warp in each four-grouping is allowed to float from one 1/1 weft-interlacing to the next (see figs. 290 and 291) with the result that the order of interlacing for alternate wefts is 3/1 instead of 2/2, and the two faces of the structure are *dissimilar.* On one face (fig. 290) the 3/1 interlacing often appears to be under-1-over-2 because the floating warp is in line with, and is concealed by, one which passes over it.

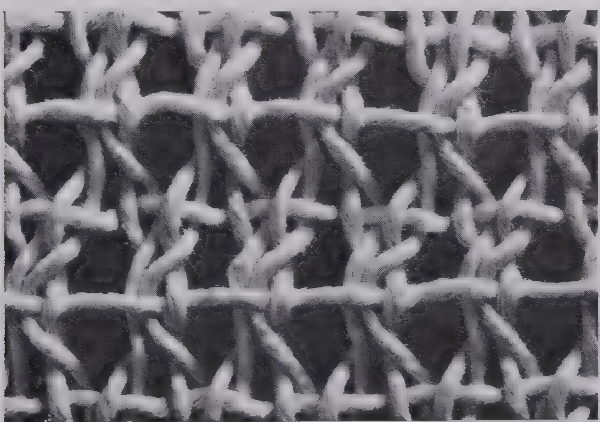

FIG. 290 One face of a *complex alternating gauze-weave* structure in which one warp in four is allowed to float from one 1/1 weft interlacing to the next. The opposite face is *dissimilar.*

NOTE: that an omission of points of involvement can be employed at intervals in an otherwise *simple gauze weave* to create open spaces much as in *interlinking* (see fig. 71, p. 62) and often with very similar effect, except that in *gauze* there are always wefts passing across the open spaces. It is also interesting to note the similarity between the zigzag paths followed by warps in *plain alternating gauze weave* (fig. 285, p. 183) and those of the elements of a single set in *interlinking* (fig. 66, p. 61). This explains the occasional mistake of construing 'interlinking-with-wefts' as a *gauze weave*. The difference lies, of course, in the interaction between the elements of the same set which, in *interlinking*, are actually linked and do not require wefts to secure their relationship as *gauze* warps do.

Another type of *gauze* structure, which is classified here as *complex* (although it can be completed on two weft passages) is based on groups of three warps instead of an even number, and therefore has *dissimilar* faces and at least two different numerical orders of warp-interworking. This apparently was not an inevitable development from *plain gauze weave* like the other modifications and elaborations discussed so far, and does not seem to be found in native fabrics of the Western Hemisphere at all. Its earliest use and greatest elaborations seem to have been Far Eastern, but as long as the recording of specific fabric structures and their development remains as incomplete both in range and precision as at present, it will continue to be impossible to determine either its origin or its distribution.

In the simplest form of the structure every third warp is crossed over two adjacent ones; is retained in the crossed position while one, two, or three (and sometimes more) wefts interlace; and is then re-

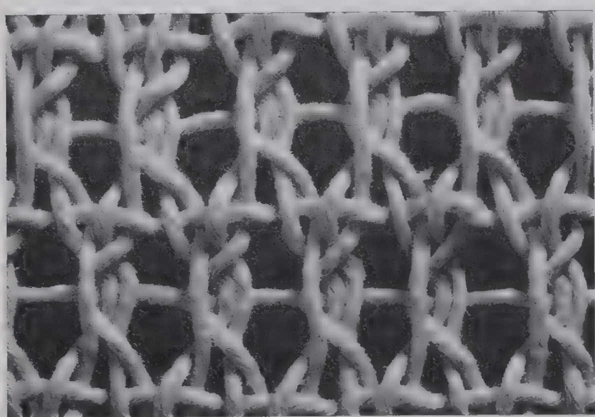

FIG. 291 Opposite face of fig. 290, showing each fourth warp omitted from alternate gauze interworkings.

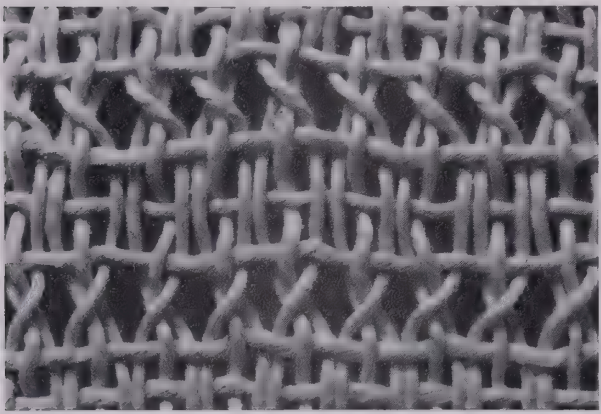

FIG. 292 *Uneven gauze crosses*, formed when one warp crosses and re-crosses two others which do not interwork with each other. Three wefts interlace the warps 2/1 between the crossing and the re-crossing. The opposite face of the structure is *dissimilar*.

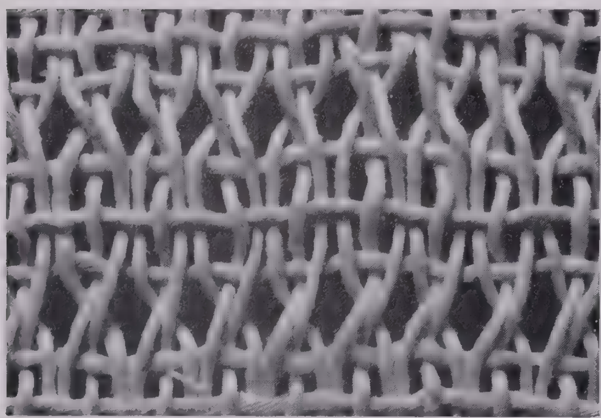

FIG. 293 Opposite face of fig. 292.

turned to its original position. This means that the warp-interworking order of one warp is over (or under) two, that of the other two, under (or over) one. Thus while one warp in three interworks with the other two, they do not interwork with each other. The weft-interlacing order is 2/1, and the faces are, of course, structurally *dissimilar*. If there is more than one weft interlacing between the crossing and re-crossing movements, the crossing warp may be interlaced by the wefts as in figures 292 and 293 or it may *float* under (or over) all of them.

Although an *uneven* grouping of warps (e.g. 2 and 1) is obviously not suited to the production of *alternating* structures like those in figures 285 and 289 (pp. 183 and 185), it is adaptable to reversal of the directions of warp shift like that in figure 284 (p. 182) and to other more complex structures such as, for example, one in which two warps are not only crossed and re-crossed at intervals by a third warp but also cross and re-cross each other in *plain gauze weave* in the intervals between involvements with the third warp. The interlacing order of the wefts may vary but tends to be 2/1 and is never consistently *even*. Alignment is consistently vertical, and the faces of the structure are always *dissimilar*.

VARIANT USES OF GAUZE WEAVES

PATTERNING *Gauze-weave* structures can play any of a number of different roles in the production of patterned fabrics. They can be used to produce either 'weave-' or 'area-' patterning, with or without color contrasts. They can be *supplemented* by other weaves, *supplementary* to other weaves, or *combined* with other weaves, either *gauze* or rectilinear *interlacing*.

For 'area-patterning' (or 'figuring'), a *gauze weave* may serve as a ground weave to which *extra-weft interlacing* is added (to produce fabrics sometimes described as 'brocaded gauze'); or it may be used for background areas when pattern areas are in a contrasting weave (*tapestry weave*, for example). It may also be used for pattern areas against background areas of a different weave (e.g. *plain weave*); or two *gauze weaves* may be used in combination, one composing background areas, another pattern areas. In addition, *plain gauze-weave* fabrics are particularly useful as a base for embroidery. (Often 'running stitch' or 'double running stitch' is used to produce an effect similar to that of *tapestry weave*.)

Although often slight, there is – as a result of the shifting direction of warps – some patterning ('weave-patterning') inherent in the interworking of all *gauze weaves, simple* or *complex*. We have noted (p. 185) the possibility of creating an openwork patterning in some *gauze weaves* by an ordered omission of certain of the regular *gauze* interworkings, and also (p. 182) the possibility of exploiting any patterning inherent in a *gauze weave* by introducing contrast in the color (or quality) of different warps. The fact that such patterning does not necessarily involve openwork is illustrated by the small Peruvian bag detailed in figure 294, whose appearance belies its gauze-related structure.* Paired yarns compose both warp and weft units; the weft is red, while in the warp two red units alternate with two natural colored ones. The same two warp units (one of each color) cross and re-cross each other throughout, with

the direction of the crossing reversed in every third column; and there are correlated reversals of the relationship of the two colors in each column, with the color relationship changing where the direction of the crossing does not, and vice versa. In contrast to regular *gauze weaves* each warp unit passes alternately over and under successive wefts, as well as over or under its companion warp unit. (This and similar structures are sometimes described as 'irregular gauze.')

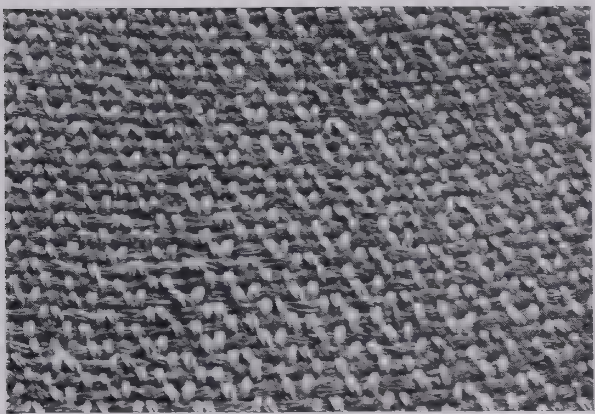

FIG. 294 Detail (x1½) of a small bag from Peru (T.M. 91. 134) woven of red and natural alpaca in vertically aligned simple *gauze weave*, 'full-turn,' countered, with 2 non-holding wefts between gauze (or holding) wefts.

NOTE ON 'DIVERTED' SUPPLEMENTARY WARPS

Also without any openwork association, although usually assumed to be related to *gauze* in structure, is a form of patterning created by 'diverting' *supplementary* decorative warps from their normal longitudinal courses. These *supplementary warps* cannot be said to interwork with other warps as 'gauze' warps do; instead, they move in diagonal floats, not simply across other warps but across the interlaced warps and wefts of a ground-weave fabric, before being secured in the new position by a weft passage. The 'diverted-warp' structure is not *supplemented* by an extra set of elements (as in so-called 'brocaded gauze') but is itself *supplementary* to a complete ground weave. These *supplementary warps* are usually spaced, often quite widely; they follow zigzag courses on the surface of the fabric, held in each successive position either by certain of the regular weft passages of the ground weave or by moving to the opposite face of the fabric. The numerical extent of the warp shift and the intervals between changes of warp direction both tend to be considerably greater than in typical *gauze-weave* structures. Figure 295 shows a characteristic diamond pattern produced when the *supplementary warps* alternately diverge and converge in diagonal floats on one face of a fabric. (In this particular fabric, diamonds are formed on one face, then the warps are shifted to the opposite face and the pattern repeated there.) Another typical pattern consists of transverse rows of chevrons and is produced by shifting the extra warps to the opposite face at each change of direction; still other patterns are created by extra warps shifting on parallel zigzag courses, and so on. This type of patterning, often designated *transposed-warp patterning*, but more clearly differentiated as *diverted-warp patterning* (see p. 189), exemplifies one of the assorted applications of the 'gauze' principle to which the term *leno* sometimes refers (see pp. 190 ff.).

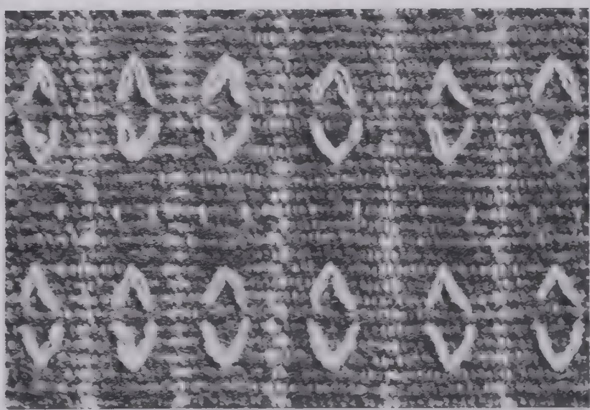

FIG. 295 Detail of a *warp-faced*, warp-striped *plain-weave* cotton fabric from Peru (T.M. 1961-30-199) patterned by diamonds formed when pairs of *extra-warp* units alternately diverge and converge in diagonal floats on the same face of the fabric.

NOTE: that in another patterning technique which is probably a mechanized-weaving development, *supplementary warps* are drawn not diagonally but transversely – actually parallel to the weft – across (but not interworking with) a number of the warps of a ground weave; they are secured by a weft, and are then re-crossed (again in the weft direction), and so on, creating usually small and discrete units of pattern. This is known as *lappet weaving*. The *supplementary warps* trend in the warp direction only when floated between pattern units, and these floats are often cut away in the finishing of the fabric, leaving little evidence of the method.

2. TRANSPOSED-WARP WEAVES

Since it can be argued that *gauze weaves*, being characterized by transposition of warps, are in a literal sense 'transposed-warp weaves,' a distinction between *gauze* and other 'transposed-warp' *weaves* is to a certain extent an arbitrary one and its basis must be carefully selected and defined. If the distinction is based on the presence of certain ungauze-like fabric qualities, for example, the relatively compact texture of the diamond-patterned weave in figure 294 might seem to justify classifying it as a 'transposed-warp' *weave* rather than as a variation of the *gauze-weave* structure. But if classification is to be based on structural determination, the designation 'transposed-warp weave' should be reserved for weaves which can be clearly differentiated structurally from *gauze weaves*, and a careful distinction should be made between 'transposed' and 'diverted' warps (see p. 189).

There are, of course, the structures mentioned on page 67, in which weft elements are added to the *one-set-of-elements* of *oblique interlacing*, which might be called 'transposed-warp weaves.' They are weaves in which the elements of a single longitudinal set, following diagonal courses throughout the fabric, not only interlace with other elements of the same set as they proceed on the opposite diagonal, but are, in addition, interlaced by transverse (or 'weft') elements. However, this construction is usually used for narrow non-loom-woven fabrics and is apt to be construed not as a weave which involves 'transposed warps,' but as *oblique interlacing* (or *braiding*) 'with wefts'— which seems reasonable inasmuch as the elements of the single (longitudinal) set form a coherent fabric structure without the addition of transverse elements.

But in certain otherwise *plain-woven* structures — like those in figures 296 and 297 — selected warps digress at certain points and move, for a space, on diagonal courses. They are interlaced by the regular passages of weft elements, at the same time interlacing other warps whose paths they cross. To be more explicit: as certain warps move diagonally in the fabric, those they cross digress slightly — a few at a time — to pass, along with the regular weft, through the part of each regular shed that is formed by the warps that are proceeding on diagonal courses. These are the weave structures for which, it would seem, the designation *transposed-warp weaves* should be reserved; and the most significant structural distinction between them and *gauze*, or gauze-related, *weaves* — the major one justifying a different technical term — lies in the fact that the wefts do not function as the sole means of securing diverging warps in each of their changing positions in relation to other warps. There is often a quite marked difference, too, in the extent of the diagonal courses between changes of direction.

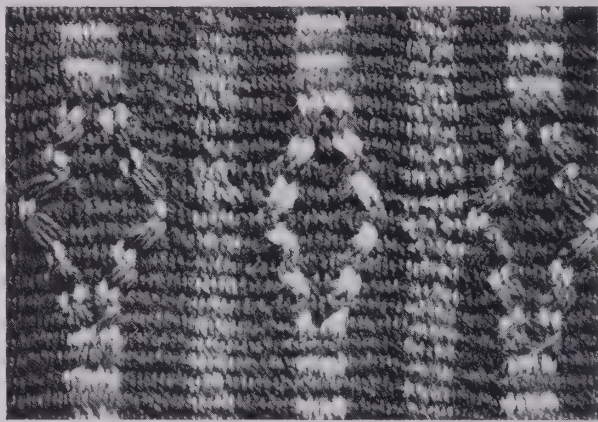

FIG. 296 Simple use of *transposed-warp weaving* to vary the pattern of 3-color warp stripes in a warp-faced alpaca fabric from Peru (T.M. 1961-30-210). Red and white warps from the center of each dark blue stripe diverge to form diamond shapes, with the dark blue warps shifted, a few at a time, to fill the centers of the diamonds.

FIG. 297 More elaborate use of *transposed-warp weaving* to pattern, with opposing zigzags, series of eight 2-color warp stripes in a warp-faced warp-patterned llama (?) wool poncho from Chiu-Chiu, Chile (No. 312133, U. S. National Museum, Washington, D. C.).

Notes on the Use of Terms

Cross · Transpose · Deflect · Divert

The use of a number of different words as synonyms often hinders clear communication of exact concepts and precise information. The terms *crossed* and *transposed* are often used interchangeably, as are *transposed, deflected,* and *diverted.* All four terms are employed repeatedly in fabric description and terminology; but all could be used more effectively if their meanings were delimited (with as little arbitrariness as possible) by taking cognizance of the ways in which their meanings vary, or tend to vary – that is, by stressing their differences rather than their similarities. Consideration of even very slight differences in the meanings of these terms and their applicability cannot fail to elucidate to some extent the structural variety with which elements can deviate from their normal courses.

In general, the term *cross* has wider application than *transpose*; *cross* meaning simply 'to lie or pass across' or 'to intersect,' whereas *transpose* specifically connotes an interchange of positions. The word *crossing* describes one of the basic relationships (in fact the simplest possible one) between two elements of the same or different sets, as distinguished from *linking, looping,* et cetera. The term *transpose,* on the other hand, presupposes a given order or series. It is defined as 'to alter the order of,' 'to alter the relative position of,' or 'to alter the position in a series.' Thus most *crossed warps* are in fact *transposed,* since *warps* are by definition (p. 74) arranged in parallel series, and if they *cross,* their order is necessarily altered; whereas the inter-crossings of *warps* and *wefts* in the regular rectilinear *interlacing* of loom weaving is 'crossing' in the sense of 'intersecting,' and the crossing relationship is between elements of two different sets. A crossing relationship between elements of one set can be specified by including (with a hyphen) a term that names the set (e.g. *crossed-warp weaves*).

Transposed, then, can be used to connote not just a *crossing* of elements but an interchange of their positions in an established order or series; whereas the words *deflect* and *divert* are consistently defined in terms, not of a change of order, but only of a turning aside from a regular course. Although the two words are often defined and used as if synonymous, *deflect* tends to imply a somewhat less specific change of direction than *divert* – more a swerving out of line, a veering from a direct course – and it has been used here to designate deviations of elements from their normal rectilinear courses when no *crossing* of other elements of the same set is entailed (e.g. see p. 118, as well as fig. 310, p. 202, and fig. 328, p. 217). And since *divert* is usually defined, and tends to be used, with somewhat more sense of clear-cut movement – a more definitive turning away from a given course – it has been used here to denote the divergent movement of *supplementary warps* which, in creating pattern, often diverge rather markedly (see fig. 295, p. 187). Since such pattern warps do, in fact, float diagonally across areas of a ground fabric, it may be argued that they actually cross other warps and should therefore be referred to as *crossed warps*; but being *supplementary,* they constitute a separate set of warps, and their movement in relation to other warps of the same set would be described as 'diverted' since the *supplementary warps* do not *cross* each other.

NOTE: that since when elements are *deflected* there is no alteration of the order or sequence, weft elements can be *deflected,* as well as warp. But when transverse elements actually *cross* each other, exchanging positions, it must be assumed that they are not *weft elements* but *accessory elements* added or inserted by some subsequent process such as *embroidery.*

Gauze · Gauze weave

The word *gauze* has two quite different sets of connotations and consequently two distinct uses. It can be used as a very general term whose implications are descriptive and non-technical (as in certain fabric names adopted in industrial usage); or it can be used as a specific and technical designation of a distinctive type of weave structure (or, even more specifically, of the simplest and most common exemplification of that particular type of structure). In the first or general sense, *gauze* refers to a kind of fabric marked by certain qualitative characteristics variously described as 'thin,' 'light,' 'transparent,' 'open,' 'flimsy,' 'perforated,' and so on, and so used has become part of certain fabric names like 'surgical gauze' and 'theatrical gauze.' In the second sense, while often referring to fabrics exhibiting those same qualities, it specifically connotes a 'crossed-warp'

structure and in this sense is the equivalent of the term *gauze weave* (see p. 180).

NOTE: that it is usually clear from its context whether or not the term *gauze* is being used as a technical term; and in a technical context, its use should be limited to *crossed-warp* structures. But in the event of any uncertainty, technical intent can easily be asserted by use of the term *gauze weave*, since a *gauze weave* is always a *crossed-warp* structure.

Many definitions and explanations of *gauze weaving* in general and of *simple gauze weave* in particular are stated in terms of at least partially mechanized construction. This has led to fairly wide acceptance of the concept of *gauze weave* as a weave constructed with two different kinds of warps (sometimes interpreted as separate 'sets' or 'series') — *ground* (or 'fixed,' 'regular,' 'standard,' 'rectilinear') *warps* which are not deflected from their regular courses parallel to the side selvedges, and *crossing* (or 'doup,' 'leno,' 'curvilinear,' 'turning,' 'whip-thread') *warps* which are bound by the weft first on one side and then on the other of their companion *ground warps*. This is a constructional, not a structural, concept and since the distinction between *crossing* (or 'turning') and *ground* (or 'fixed') *warps* is seldom apparent in the fabric structure and can, therefore, seldom be verified except by documentary evidence of construction methods, defining and classifying the fabric structure in terms of this distinction can only lead to confusion. It illustrates, however, one of the effects of progressive mechanization on terminology, definition, and ultimately on classification itself.

Gauze warps are often described as being 'twisted' about each other, or it may perhaps be stated that warp threads are 'made to intertwist more or less among themselves.' References to the 'twisting' of warps either 'about' or 'among' other warps is misleading. It suggests the quite different warp action in which two (or more) adjacent warps spiral, or *twine*, continuously about each other (see pp. 196 ff.). Statements describing *gauze warps* as 'taking a half-turn' or 'half-twist' about other warps are more accurate; but the more the nomenclature suggests a twisting or *twining* action for *gauze warps*, the easier it is to fail to distinguish between the different types of *interaction* among elements of the same set in *gauze weaving* as opposed to *twining*.

Gauze · Leno · Fancy gauze

In present-day usage there is clearly some sense of relationship between *gauze* and *leno*, but there are many different concepts of the nature of the relationship. One is the concept of equivalents; that is, the two terms are considered synonymous, and each is apt to be defined in terms of the other as in 'gauze weave, sometimes spoken of as leno weave,' 'leno weaves, known as gauze weaves,' and so on. Another concept — which may be said to qualify the equivalence — is limited, I think, to American industrial and possibly hand-weaving usage and is often implied (rather than stated) by the use of *leno* to describe a specific type of weave structure and *gauze* to designate a 'fabric woven in leno.' According to a still different concept both terms refer to *crossed-warp* fabrics but to different kinds. They are often defined in such a way as to imply structural differences although the definitions are stated in words that are largely qualitative: *gauze* being defined as a 'light,' 'openwork,' 'perforated' fabric as opposed to *leno* which is identified as 'heavy, with surface zigzagging' or as having 'crossing' warps 'applied decoratively to heavier textures.' (Thus defined and described, *leno* apparently refers to the *crossing* or *diversion* of *supplementary warps* over the surface of a ground weave — see page 187.)

But often when *gauze* and *leno* are differentiated, it is on the basis of structure alone; and while there is considerable difference in the way the structural distinction between them is expressed, it tends to involve the use of wefts other than those that secure the warps in their successive positions. For example, it may be specified that in *gauze* there is 'only one weft between crossing warps' whereas in *leno* there is 'more than one filling inserted for every crossing of the warp yarns'; and the same distinction is made when it is stated that *leno* is 'a combination of plain weave and gauze' or is *gauze weave* 'with an odd number of tabby picks.' Both distinctions obviously refer to certain wefts that are not holding- or gauze-wefts being used either one at a time as shown in figure 286 (p. 183) or in larger (uneven) numbers in succession (as in figs. 280, p. 181; 292 and 293, p. 186). Another similar distinction is designated by an inadequately defined term, *half-gauze*, which apparently almost always refers to a *plain gauze weave* with single intervening wefts alternating with holding- or gauze-wefts, that is, a weave showing the

same relationship to the weave in figure 282 (p. 181) as that in figure 286 does to figure 285. This weave is described as being identifiable by the fact that 'if alternate wefts are removed, a plain gauze will remain'— which seems tantamount to saying that, as noted on page 183 in reference to the weave in figure 286, alternate wefts are *supplementary*. The identity of the *half-gauze* structure seems clear but its relation to *leno* is not; since according to some writers *half-gauze* is known as *leno,* while others designate the same structure as *half-leno* but differ about whether or not it is the equivalent of *half-gauze* — some refer to 'half-leno weave, sometimes called gauze.' And through it all we are left to wonder how much these terminological differences result from basic differences in the use of the terms *gauze* and *leno,* that is, whether — and when — one may be meant to refer, for example, to a type of fabric and the other to a weave structure. The terms *full-gauze* and *full-leno* usually refer to the *plain gauze weave* and often seem to be used only to explain *half-gauze* — or *half-leno.* But *full-cross gauze* apparently refers to what is described by others as 'double-turn' (or 'full-turn') *gauze,* that is, one in which companion warps encircle each other completely between weft passages.

Actually, historically, the distinction between *gauze* and *leno* was probably a distinction between fabric types, made on the basis of fiber rather than structure: *gauze* referring specifically to silk gauze and *leno* to linen or cotton. Although the term *gauze* is not now associated solely — or even largely — with silk, or the term *leno* with linen, this may well have been the original basis for the use of two such apparently unrelated words for the same weave structure and may both indicate and explain the origin of the word *leno.*

The word *leno* may not have been used in English at all prior to the 19th century. It is commonly said to derive from the French *linon* but there is usually no attempt to explain the derivation of meaning. Another derivation occasionally suggested is from the name of the French city of Laon and is associated with the more directly derived word *lawn; leno* is said to connote 'cross-woven' or 'gauze-woven' 'lawn' but again there is no explanation for the implication of *cross-weaving.*

At the same time it has been glibly reiterated, almost as many times as the term *gauze* has been defined, that both the word and the weave came 'from Gaza, in Palestine' (or 'in Asia,' or 'the Near East'). It is often implied and sometimes specifically stated that the reason the weave is known as *gauze* is that it originated in Gaza, which seems highly debatable since it is apparently impossible to find examples of the weave attributable to the ancient Near or Middle East or indeed to any part of the ancient world except the Far East and the Americas. The word *gauze* first appears in English (according to the *Oxford English Dictionary,* 1933) in 1561, and is said there to be derived from the French *gaze.* But the origin of the French word *gaze* is repeatedly referred to as 'uncertain' or 'unknown' although Du Cange in 1678 identified *gazze* with the late and medieval *gazzatum* which he said referred to a very finely woven silk or linen and was so named because it was first brought from Palestinian Gaza (Du Cange, 1937–38, vol. 4, p. 49). More than one 20th century dictionary of textile terms defines *gazzatum* as "fine and sheer silk or linen gauze of the Middle Ages . . ." (Harmuth, 1915, p. 70, for example) but neither the French word *gaze* nor the Latin *gazzatum* appears in the *Glossaire archéologique du Moyen Age et de la Renaissance* (Gay, 1887). However, what seems to be a more plausible source for the word *gaze* has been suggested by Partridge (1959, p. 248), namely the Arabic *gazz* — meaning floss silk — a derivation which seems equally applicable to *gazzatum.* Furthermore, the idea that the origin of the fabric name *gauze* may have been *gazz,* rather than *Gaza* (variously spelled *Ghazzah, Ghazzeh, Ghazza, Azzah, Azza*), a town out of which the fabric was traded, is supported by the fact that the French *gaze* seems to have referred chiefly to silk gauze, while the term *linon* was used to refer to 'a [linen] openwork fabric resembling gauze' (Bezon, 1856–63, vol. 5, p. 215), specifically one with three wefts in *plain weave* between gauze wefts, a fabric also called "linon à jours" or "gaze de fils" (*ibid.*; Dantzer and de Prat, 1934, p. 82).

At present, however, as we have noted, both terms — *gauze* and *leno* — seem to have lost any significant fiber association they may have had. Since there seems to be no advantage in having two different technical terms that are identical in meaning, and since in many European languages the term for *gauze* is a closely and recognizably related word (each presumably derived, as is *gauze,* from the French *gaze*), it would seem that from the point of view of ease of translation as well as general under-

standing based on long and wide-spread use, the word *gauze* is more useful as a designation for the specific *crossed-warp* type of weave than is *leno*.

If *leno* is to be distinguished from *gauze*, perhaps the best of the numerous distinctions already in use is the one which identifies *leno* as a structure in which rows or areas of *gauze weave* are separated by, or combined with, areas of *plain weave*. But this particular use of the term *leno* is also one of several uses of the term *fancy gauze*; in fact, *leno* is sometimes defined as 'fancy gauze.' The word *fancy* seems to be used in much the same very general way when applied to *gauze weaves* as when applied to various simple interlaced weaves (see p. 123); that is, the term *fancy gauze* tends to be used as a general term simply connoting deviation from the plain or standard form of *gauze weave*. Differences in exact meaning usually rest in part at least on differences in the concept of what constitutes the plain or standard weave. But *fancy gauze* is sometimes defined somewhat more specifically – as any fabric in which *gauze weave* is used to produce pattern (see p. 186 for notation of various possible ways). Thus we find that while to some *leno* is the equivalent of *gauze*, and to others it implies a special use of *gauze* (in combination with *plain weave*, for example, or for *extra-warp patterning*), to still others, any such special use of the *gauze weave* is *fancy gauze*, and *leno* refers instead to elaborations of the *gauze weave*. Ordinarily, however, whenever the intended meaning of the term *fancy gauze* is clearly set forth, the term is associated with 'patterning' or with 'ornamental effects.'

It is suggested therefore that if the characteristic *crossed-warp* type of weave is designated *gauze*, with the basic forms identified as *simple* and the elaborations as *complex*; then the term *fancy gauze* can be used for combinations of two or more different *gauze weaves* that produce patterning, and *leno* for combinations of *gauze* with a *plain* (or some other *interlaced*) *weave* structure.

NOTE: that *plain* (1/1) *gauze weave* (fig. 282, p. 181) is sometimes described as 'two-thread' *gauze* and thus differentiated from *plain alternating gauze weave* (fig. 285, p. 183) which is described as 'three-thread' *gauze* (note, for example, "deux fils" and "trois fils," d'Harcourt, 1934, fig. 29, p. 54). The description 'two-thread' correctly reflects the fact that in the basic gauze structure to which it refers, the warps work in twos throughout and only two warp elements are necessary to establish the essentials of the weave structure; but 'three-thread' can be misleading since, in the weave it usually refers to, four warp elements are necessary to establish the structure. Effective use of this style of nomenclature ('one-thread,' 'two-thread,' 'three-thread,' etc.) for differentiating *gauze-weave* structures is hindered, first, by insufficient explanation and justification of the exact relationship of the terms to the structures they are supposed to designate, and also – perhaps in consequence – by use of the same terms by different individuals for quite different gauze structures (e.g. the radically different use of 'two-thread' for the more complex structure, illustrated here in fig. 289, p. 185, in Bellinger, 1954, p. 96).

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PART TWO

Classification of the Structures of Fabrics

I Felted Fibers

II Interworked Elements

- A. Single Element
- B. Two Single Elements
- C. One Set of Elements
- D. Two or More Sets of Elements
  - 1. Interlacing warps and wefts
  - 2. Interacting elements
    - a. Crossing and re-crossing
    - b. Twining
      (*see below*)

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b. TWINING

1). Warp-twining

Variation:

- a.) In direction of twining-twist
  - Countered
  - Reversed
  - Inverted
- b.) In grouping of weft elements
  - Alternate-pair
- c.) In degree of twining-twist
  - Full-turn
- d.) In number of components of the warp group
  - Multiple-strand

Note on methods of warp-twining

Note on the use of color

2). Weft-twining

Compact or spaced

Variation:

- a.) In direction of twining-twist
- b.) In grouping of warp elements
  - Alternate-pair
- c.) In degree of twining-twist
  - Full-turn
- d.) In number of components of the weft group
  - Multiple-strand
- e.) In warp movement
  - Diverted or transposed

Variant uses:

- 'Pile'
- Pattern

NOTES ON THE USE OF TERMS

Twining • *Pairing* • *Cording*

Twining: *Compact* • *Spaced* • *Openwork*

Twining: *Twill* • *Diagonal* • *Split-pair* • *Alternate-pair*

Basketry • *Cloth*

Twining: *Wrapped* • *Bird-cage* • *Lattice* • *Crossed-warp*

SOURCES OF INFORMATION

B. TWINING

When, instead of *crossing* and *re-crossing*, pairs (or larger groups) of adjacent elements of one set spiral or turn about each other in their passage through a fabric, enclosing successive elements of the other set in each turn or half-turn, they produce distinctive structural and fabric characteristics and are variously described as being 'twined,' 'paired,' 'chain-twisted,' or 'cross-twisted' (and the fabric is described as 'twined' or ,sometimes 'corded'). By definition, at least two *twining* elements act together (see p. 64), the same two usually twining about each other throughout a fabric; and if the number of *twining* elements is even, the two faces of the fabric will be structurally *identical.* Either warps or wefts can be *twined* (and on occasion both are); whereas only warp elements can be *crossed* or *transposed.*

Perhaps because *twining elements* cannot function singly, being worked in groups of at least two, close-twined fabrics have been described as 'double' or 'two-ply'— although they are not 'double' in the sense that *compound interlaced weaves* are when, for example, one set of elements (or one weave) constitutes one face of the fabric and a *complementary set,* the opposite. They are more akin to *warp-* or *weft-faced plain-weave* fabrics since, in the basic form of *twining* (i.e. *two-strand twining* that encloses one unit of the opposite set at a time), each *twining element* passes alternately over and under successive elements of the opposite set as it twines about its companion element. But in contrast to *interlaced weaves* and unlike the warps in *gauze-* and other *crossed-warp weaves, twining elements* can hardly be said to interlace (or be interlaced by) the elements of the opposite set; they simply 'enclose' or 'clasp' the non-twining elements in their *twining interaction* with each other. Nor do the non-twining elements secure the twining itself (as gauze wefts secure the crossing of gauze warps); they serve only to join successive groups or 'cords' of twined elements in a coherent fabric, and if they are removed the twined elements remain twined — but as separate cords, not as a fabric.

In addition, it should be noted that although the 'cords' formed by the *twining elements* are at right angles to the non-twining elements, the individual elements that compose the twined 'cords' cross the non-twining elements at an oblique angle. They always slant either to the right or left (according to the direction in which they twine about each other) and although the slant is sometimes so slight as to be barely discernible it constitutes the only visually distinctive characteristic of both *warp-* and *weft-twining.*

NOTE: that it is sometimes assumed that as a fabric term, *twining,* when unexplained and unqualified, refers to *weft-twining.* It seems both more logical and more practical to use the term *twining* whenever the same structure is encountered whether it be in warp elements, weft elements, or those of a 'single set,' and to specify *warp-, weft-,* or *oblique-twining.*

Warp-twining and *weft-twining* are homologous not only in basic structure but in many types of structural variation. The simplest (and the basic) form of each is plain *two-strand twining,* a form in which each pair of *twining elements* encloses successive units of the opposite set, one at a time. The major variations common to both are: 1) variation in the direction of the twining-twist (and the slant of the twining elements) either in adjacent twining groups or from point to point in each; 2) variation in the number and succession of non-twining units enclosed; 3) variation in the amount or degree of twining-twist between passages of non-twining elements; and 4) variation in the number of components of each twining group.

However, there is an important additional possibility of effective structural variation which occurs in *weft-twining* alone, namely, the possibility of 'spacing' the twining groups and thereby exposing the non-twining elements to view. While *warp-twining* is consistently 'compact,' or 'close-twined,' concealing the non-twining elements, *weft-twining* can be either correspondingly 'compact' or it can be 'spaced'— that is, twined groups of wefts can be either close together or, if the twining tension is such as to maintain them, placed at intervals along exposed non-twining warps. The warps then assume visual importance and provide further possibilities of variation.

NOTE: that pattern in 'compact' *twining,* whether warp or weft, tends to be developed by manipulation of the twining elements in order to vary the color (see p. 200); whereas when *weft-twining* groups are 'spaced,' *crossing* of *warp elements* becomes an important additional device for both structural and color patterning (pp. 204 f.). Since the number of components of the twining groups is often greater in *warp-twining* (particularly when *tablet-woven,* see p. 199) than is customary in *weft-twining,* the effect of 'cording' tends to be more pronounced.

1. WARP-TWINING

Contrary to some opinion and to occasional statements, *warp-twining* is related to the *crossing* and *re-crossing* of warps in *gauze weaves* more in the way it is usually described than in its actual structural make-up. Both structural types are marked by *interaction between elements of the same set*, but the kind of interaction is quite different, as are the resulting fabrics. In *twining*, of course, the interaction involves repeated spiralling of the twining elements about each other, and far from tending to produce openwork, as the *crossing* of warps does in *gauze weave, warp-twining* tends to produce compactly *warp-faced* fabrics varying in relative thickness according to the number of warp elements twined together in each 'cord' (see fig. 298).

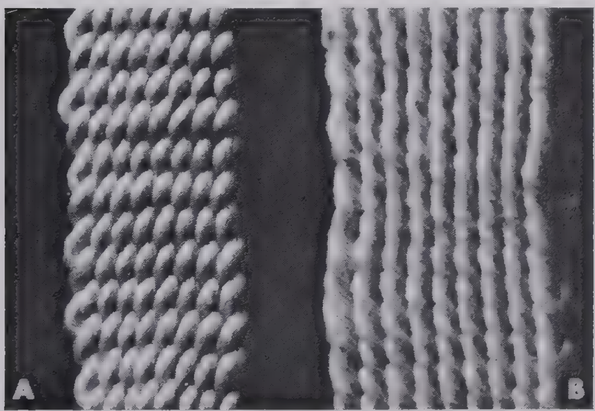

FIG. 298 *Compact warp-twining*: a) *2-strand*, or 2-part, *twining* with a Z twining-twist; b) *4-strand*, or 4-part, *twining* with an S twining-twist. Either could be 'tablet-woven' (as these were); each has structurally *identical* faces.

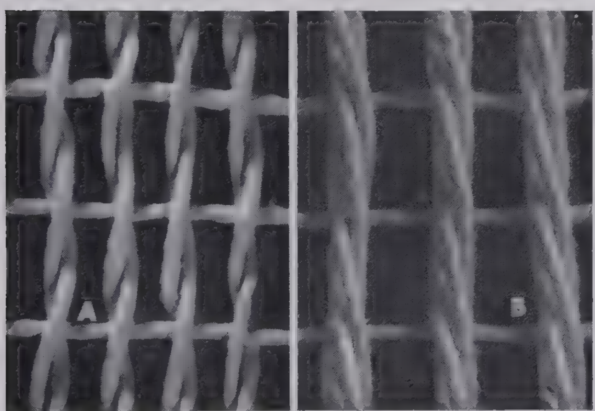

FIG. 299 Diagrammatic construction of *warp-twining*, with space left between the twined 'cords' to show their relationship to the passages of weft: a) *2-strand*, or 2-part, *twining*, with a Z twining-twist, on single weft passages; b) *4-strand*, or 4-part, *twining*, with an S twining-twist, each element passing progressively over-2-under-2 wefts.

In plain *two-strand warp-twining*, each two warps spiral continuously about each other, always in the same direction, alternating on each face of the fabric as they enclose a weft unit in each 'half-turn' (fig. 299, *a*). The direction of the twining-twist can be either S or Z, but the two faces of the fabric are structurally *identical* and the direction of the twist is the same on both. The 'slant' of the twining elements in relation to the non-twining ones, although sometimes difficult to detect, is always present and its direction, which is the same as the direction of the twining-twist, should always be noted.

NOTE: that in *warp-twining*, the direction of the twining-twist and the direction of the slant of the twining in relation to the non-twining elements are the same, and can be identified as either S or Z; whereas in *weft-twining* (see fig. 306, p. 201) they appear to differ, and it is the actual direction of the twining-twist that should be identified.

VARIATION:

A. IN DIRECTION OF TWINING-TWIST

COUNTERED In one of the widely used variations of plain *two-strand warp-twining*, the direction of the twining-twist is changed in each successive twining group (see fig. 300). This does not affect the *identity* of the two faces of the fabric. When thus marked by constant reversal of the twining-twist, *warp-twining* can be described as 'countered' or 'counter-twined.' It has been specifically termed "counter-paired warp-twine" (e.g. Kent, 1957, p. 655)

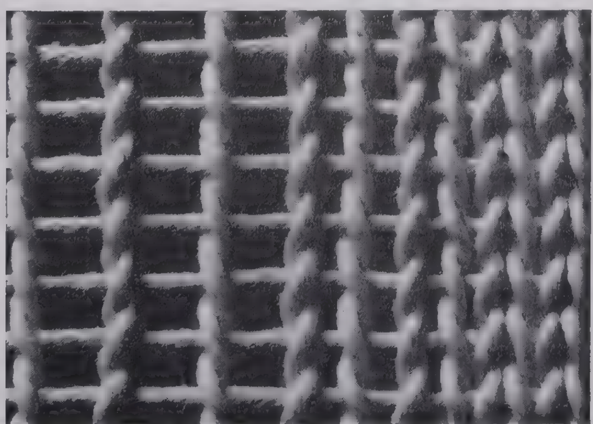

FIG. 300 Diagrammatic construction of *countered 2-strand warp-twining*. The direction of the twining-twist is reversed in successive 'cords' (S, Z, S, Z, etc.). The two faces are *identical*.

but usually its appearance is merely compared with that of knitting, 'plaiting,' 'chaining,' or some other structure – which tends to be misleading inasmuch as any similarity is wholly visual.

REVERSED If the changes from one direction of twining-twist to the other occur at intervals across the fabric instead of in successive twining groups, parallel longitudinal areas of textural variation will replace the effect of 'plaiting,' and the *twining* can be described as 'reversed' instead of 'countered.'

INVERTED If changes in the direction of the twining-twist are made at intervals along each 'cord,' the areas of textural variation will be transverse (see fig. 301) instead of longitudinal, and the *twining* could well be described as 'inverted.'

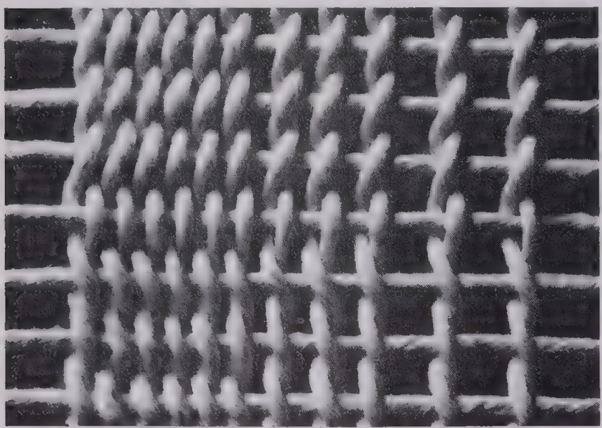

FIG. 301 Diagrammatic construction of *inverted 2-strand warp-twining* with the direction of the twining-twist changed at a given point in each 'cord.' It is S below the change, Z above, and the two faces are *identical.*

B. IN GROUPING OF WEFT ELEMENTS

ALTERNATE-PAIR Another common variation of *two-strand warp-twining* is produced when the warp elements composing each twining group enclose two weft units at a time in a pairing that alternates from one warp group to the next (see fig. 302). The 'slant' produced by the *warp-twining,* in combination with repeated *alternate pairing* of the wefts, produces an appearance similar to that produced by the diagonal alignment of floats in a *warp-faced twill weave* (e.g. fig. 118, p. 93); and when the diagonal is clearly discernible, the twined structure is often described as 'twill twining.' Actually, however, the alignment is alternating; the direction of the seeming diagonal is the same on both faces; and reversing the direction of the twining-twist produces an appearance of reversed diagonals (see fig. 303) which is utilized for both herringbone- and diamond-patterned fabrics that are often mistaken for *warp-faced twills.*

NOTE: that under certain circumstances, particularly if the wefts are rather widely spaced and the warps very firmly compacted, only the actual alternation of the points of interaction will be apparent and there may be no suggestion of a diagonal unless produced by color succession (see p. 200 for further comment on the use of color).

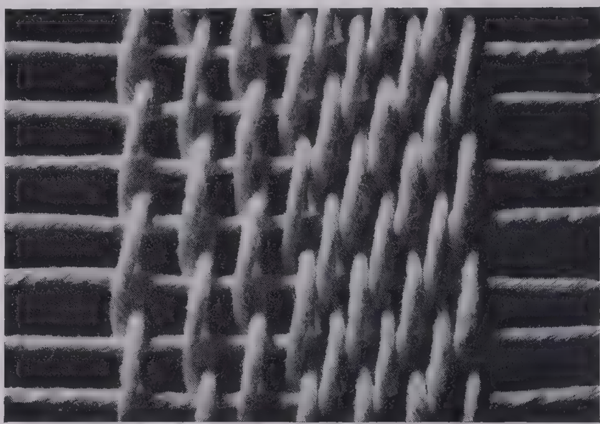

FIG. 302 Diagrammatic construction of *2-strand Z-twist warp-twining* in which successive groups of twining elements enclose two wefts at a time in *alternating pairs,* producing, when compacted, a twill-like appearance of diagonals and sometimes described as 'twill twining.' The two faces are *identical.*

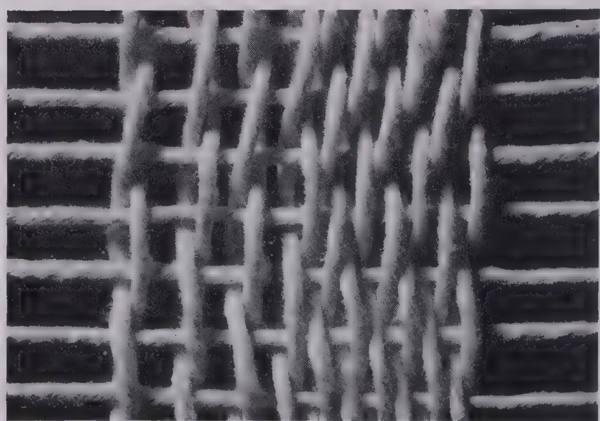

FIG. 303 *Inversion* of the *2-strand alternate-pair warp-twining* structure diagrammed in fig. 302. Changing the direction of the twining-twist midway in each 'cord' makes it appear that the 'diagonals' reverse at that point. The two faces are *identical.*

C. IN DEGREE OF TWINING-TWIST

FULL-TURN The twining-twist between passages of the non-twining element normally amounts to a 'half-turn.' This can be varied either by making the

turn complete ('full-turn') or by making no turn at all; but these variations serve almost exclusively as means of color control (see figs. 313 and 314, p. 203, for equivalent variation in *weft-twining*).

D. IN NUMBER OF COMPONENTS OF THE WARP GROUP

MULTIPLE-STRAND If the number of warp units in each twining group is increased, the number of weft units each passes over will also be increased, and the two faces of the structure will not necessarily be *identical*. In *three-strand warp-twining*, for example (see fig. 304), the two faces are *dissimilar* in both structure and appearance although the slant of the twining elements will be the same on both.

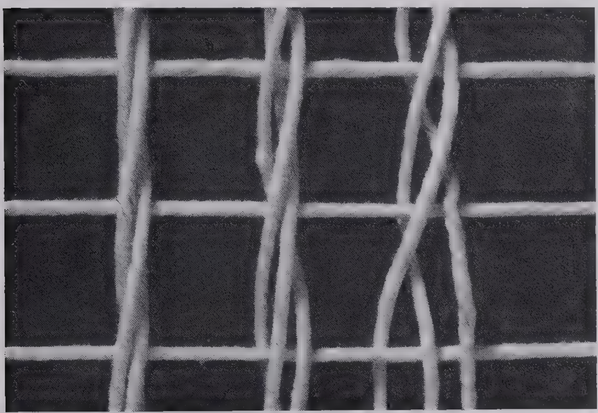

FIG. 304 Diagrammatic construction of *3-strand Z-twist warp-twining*. On this face, each of the three twining warps passes in progression over-2 and under-1 weft as it twines with its two companion warps; on the opposite face (which is *dissimilar*) the over-and-under order is reversed.

But whereas an *uneven* number of elements in the twining groups always produces *dissimilar* faces in a twined fabric, any *even* number — above two — may or may not. In *four-strand twining*, for example, each twining warp may go over two wefts and under two (see fig. 299, *b*, p. 197), producing *identical* faces, or — although this is less common — over three and under one, producing *dissimilar* faces, one of them more heavily corded than the other.

Like *two-strand twining, multiple-strand twining* can be 'countered'; the direction of the twining-twist can be changed at intervals either along or across the fabric (or both); and the wefts can be *alternately paired*. But whether the twining structure is plain or varied, the appearance of vertical 'cording' is always more pronounced and the fabric proportionately thicker when more than two warp units are twined together.

NOTE ON METHODS OF WARP-TWINING

Twining as a means of constructing a fabric does not lend itself to mechanization. It seems to have no counterpart in machine production, and its use in hand-weaving in the modern world has tended to become restricted to narrow bands, edge finishes, and small areas of decorative detail. There is, however, a mechanical device for expediting the production of *warp-twining*, namely, a set of 'cards,' 'tablets,' or 'boards.' These are thin flat pieces of bone, wood, parchment, cardboard, et cetera, each pierced by from two to as many as eight holes through which *warp elements* are threaded. The set of 'tablets' can be manipulated to form sheds through which *weft elements* can be passed and thus it functions as a 'shedding device.' Such sets of tablets apparently constitute the only special implementation ever devised to aid in the process of *warp-twining*, and as a result so-called 'tablet-weaving' is often equated with 'warp-twining,' in spite of the fact that *warp-twining* is by no means all *tablet-woven*, nor *tablet-weaving* all *warp-twining*.

Warp-twining has been found in many parts of the world where no direct evidence of the use of 'tablets' or 'cards' has ever been discovered; and it is known that, with the warps secured at both ends, *warp-twining* can be constructed by means not unlike those used to produce the 'one-set-of-element' *interlinking* and *interlacing* structures sometimes identified as *sprang* (see p. 66). *Warp-twining* or 'cording' is therefore not, as is sometimes stated, a 'certain sign of tablet weaving,' nor is it 'a weave which can be done only on tablets.' Furthermore, the 'tablet-weaving' method is known to have been used not only for *warp-twining* but for *plain weave, tubular weave, double-cloth*, even *gauze weave*. In many fabrics presumed to be 'tablet-woven,' *warp-twining* is combined with *weft-wrapping* (see p. 215) and is sometimes embellished with *extra-weft float patterning*.

When pairs or groups of warp threads twine about each other, and enclose the weft elements which pass from one edge of the fabric to the other, these successive 'cords' of twining warps tend to be consolidated by weft tension into a dense fabric structure (see fig. 298) having qualities which are particularly useful for bands, belts, et cetera. It is often stated that *warp-twining* is used only for narrow bands, and when 'warp-twining' is equated with 'tablet-

weaving' the reason usually given for this restricted use of the technique is the difficulty of handling more than a small group of cards or tablets, although it may be due quite as much to the tendency of the technique to produce particular fabric qualities as it is to limitations imposed by the technique.

Warp-twining tends to be more elaborately patterned, both by variation of the twining structure and by combination with other techniques, when it is *tablet-woven* than when it is produced by other means; but no specific means of fabrication should be postulated simply on the basis of such elaboration.

The origin of the use of tablets for *twined* or *woven* fabrics is as yet undetermined, but it is interesting to consider the possibility that it may have developed from the use of similarly-holed individual plaques for rope-twisting or for plying yarns. The presence of objects which could conceivably have served as 'tablets' in fabric construction does not constitute proof that they were used for that purpose unless they occur in adequate sets and/or in direct association with *warp-twined* fabrics.

NOTE ON THE USE OF COLOR

The basis for color control in *two-strand warp-twining* is the fact that the warps work in pairs — one above and one below each weft element, each passing alternately above and below. If the two twining warps are of different colors, and the structure is *plain twining*, the two colors will alternate on both faces. By varying the amount of twining-twist, paired colors can be manipulated to produce areas of solid color. Normally, with the *twining warps* making a *half-turn* about each other between weft passages, each warp moves constantly from face to face. But with *full-* instead of *half-turns*, each warp can be returned repeatedly to the same face of the fabric so that different colors can be used for the two faces and interchanged to produce pattern areas (see p. 203 for *weft-twining* equivalent). By combining changes in the direction of the twining twist with variety in the amount, colors can be manipulated to produce a variety of relatively simple patterns based largely on diagonals. (It should be noted, however, that although the two faces will be structurally *identical*, the pattern and color correlation between faces will not be the same as in an *interlaced* fabric of similar pattern.)

2. WEFT-TWINING

Although structurally more complex than *interlacing*, *weft-twining* was undoubtedly one of the very earliest methods of constructing fabrics with two different sets of elements. It remains one of the simplest methods, and one of those least amenable to implementation. It has served all over the world for a great variety of fabrications, from fish-weirs and wattled fences to fine and often elaborately patterned fabrics, in all types of fibers either spun or unspun that are suitable to fabric construction of any kind. Because the structure is widely used for baskets, mats, and similar objects, because fibers commonly associated with basketry are often employed for it, and also because like basketry it is in a certain sense a 'finger weave,' *weft-twining* is often classed as a 'basketry' technique and its relationship to 'loom-woven' fabrics either denied or overlooked (for use of the term *basketry*, see p. 208). But use of the *weft-twining* structure is not restricted to 'basketry fibers' and when the so-called 'textile fibers' are employed, *compact weft-twining* is often difficult to distinguish from, and is sometimes employed in conjunction with, *interlaced* structures that are usually woven on a heddled loom.

One of the radical distinctions between *weft-twining* and most 'heddle-loom weaving' (including *tablet-weaving*) is to be found in the lack of implementation. Neither heddles nor shuttles can be utilized in *weft-twining* since the wefts, instead of being passed through 'sheds,' are manipulated in pairs (or larger groups) in such a way that, as they twine about each other, they enclose successive warp units. *Weft-twining* (which is often described as 'non-woven') can be constructed with the warp elements secured at only one end, although for much *weft-twining* the warps are either weighted at the free end or secured at both ends. The structural differentiation from 'heddle-loom weaving' is found solely in the *twining interaction* of the *weft elements*. (The close correspondence between the structures of *warp-* and *weft-twining*, as well as the relationship of *warp-twining* both to *gauze weave* and to *warp-weft interlacing*, have already been noted on p. 196.)

Sometimes, if *weft-twining* is very 'compact,' it is difficult to distinguish it visually from *weft-faced warp-weft interlacing* (or from *warp-twining*, when the warp-weft orientation is unknown or indeterminate). But any *weft-twining* structure can be either

'compact' or 'spaced'; and it is in *spaced weft-twining* that we find the sole significant lack of homology between *warp-* and *weft-twining*, since *spaced weft-twining* seems to have no equivalent in *warp-twining* (nor any close analogy in 'heddle-loom weaving').

COMPACT OR SPACED The basic form of *weft-twining* is that in which two weft units *twine* about each other enclosing warp units one at a time (see fig. 306). The twining-twist may be S or Z but is unvaried and is always the same on both faces (which are structurally *identical*). When *weft-twining* is 'compact' (fig. 305), the fabric is *weft-faced* and the structure is homologous to the basic form of *two-strand warp-twining* (p. 197), which is *warp-faced*. But in *weft-twining*, there is the added possibility of 'spacing' the groups of twining elements so that the fabric is not *weft-faced* and the warp plays a part in the appearance of the fabric (see figs. 306 and 308).

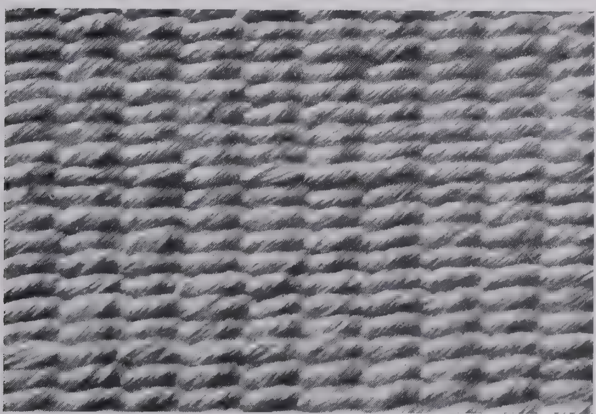

FIG. 305 *Compact 2-strand S-twist weft-twining*, enclosing one warp unit at a time. Both the structure and the S twining-twist of the wefts are *identical* on the two faces.

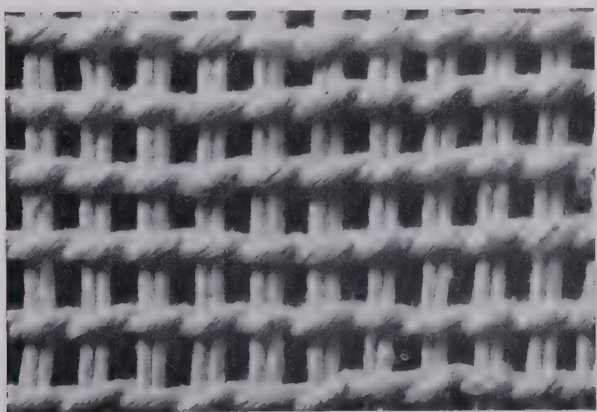

FIG. 306 *Spaced 2-strand S-twist weft-twining*, revealing the structure of fig. 305. Each warp unit comprises two warp elements. The twining-twist of the wefts is S, and both the structure and the direction of twist are *identical* on the two faces.

VARIATION:

A. IN DIRECTION OF TWINING-TWIST

Like *warp-twining* – and with comparable effect on both structure and appearance (see pp. 197 f.) – *weft-twining* can be 'countered' (i.e. the twining-twist can be changed in each successive twining row, fig. 307), 'reversed' (changed at intervals across the fabric), or 'inverted' (changed at intervals along it). In contrast to *warp-twining*, on the other hand, *weft-twining* can also be 'spaced'; but if 'spaced,' the characteristic appearance of these variations will be lost (e.g. fig. 308, *a*) – although some of the 'countered' appearance can be retained if the spacing is between 'countered' pairs (fig. 308, *b*).

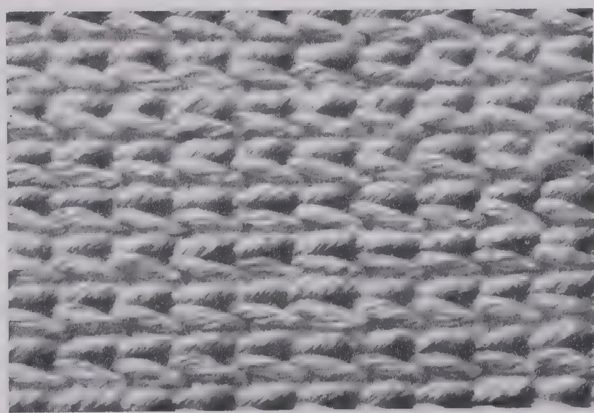

FIG. 307 *Compact 2-strand 'countered' weft-twining*: the direction of the twining-twist reversed in successive rows (S, Z, S, Z, etc.). The two faces are *identical.*

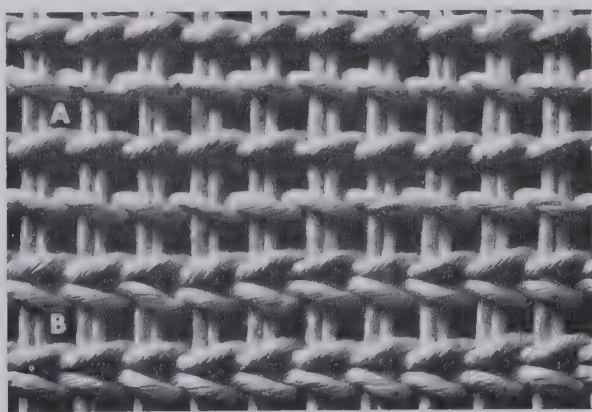

FIG. 308 *Spaced 2-strand 'countered' weft-twining* showing the structure of fig. 307. The 'chained' effect is lost when the rows are spaced (a), unless spaced in pairs (b).

B. IN GROUPING OF WARP ELEMENTS

ALTERNATE-PAIR If *twining wefts* enclose warp units in pairs and repeatedly form new pairs by splitting those in the previous row, the effect of ribbing (seen in fig. 305) will be broken up and, if the *twining* is 'compact,' there may appear to be diagonal ribs (fig. 309). This is often described as 'diagonal' or 'twill' twining (see p. 207 for discussion of terms), although on the Northwest Coast the Indian (Tlingit) word for it is said to mean " 'rough' or 'uneven' . . . from its irregular appearance" (Emmons, 1907, p. 339). As in comparable *warp-twining* (see p. 198) the direction of the seeming diagonals depends on the direction of the twining-twist and is the same on both faces; but if the *twining* is 'spaced,' the twill-like effect will disappear and the zigzagging of the deflected warps (as a result of their *alternate pairing*) will take visual precedence (fig. 310).

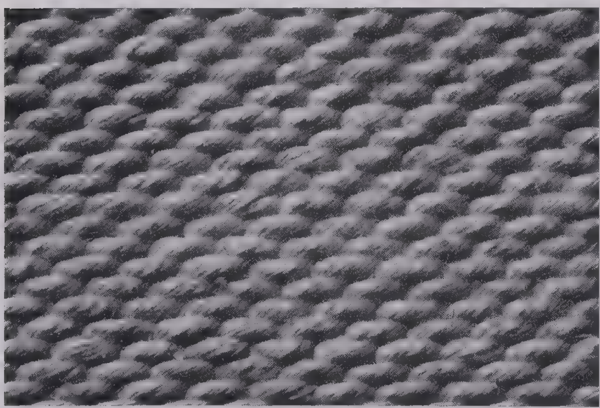

FIG. 309 *Compact 2-strand S-twist weft-twining*, enclosing warp units in *alternate pairs* in successive rows. Sometimes called 'twill,' 'diagonal,' or 'split-pair' twining. The two faces are *identical*.

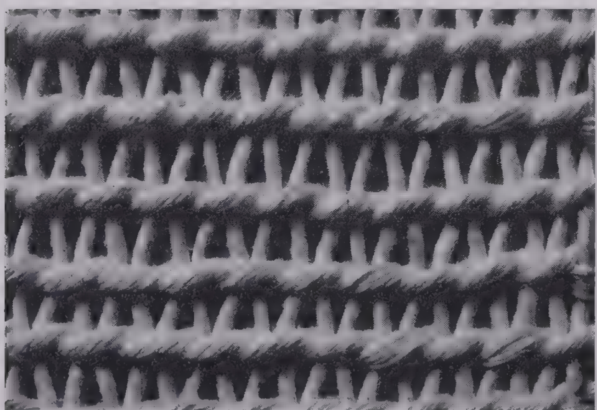

FIG. 310 *Spaced 2-strand S-twist alternate-pair weft-twining*, revealing the warp action in fig. 309. Sometimes called 'twined openwork,' 'zigzag,' or 'split-pair' twining.

NOTE: that if *compact weft-twining* on *alternate warp pairs* is 'countered' (see fig. 311), there will be no twill-like effect and the appearance may be superficially more suggestive of *plain oblique interlacing* (fig. 72, p. 63) than of either 'countered' (fig. 307) or *alternate-pair weft-twining* (fig. 309); but if the same twining structure is 'spaced,' the effect of 'countering' will be as negligible as it is in figure 308, and the zigzagging course of the deflected warps will take visual precedence as in any *alternate-pair spaced twining* (see fig. 310).

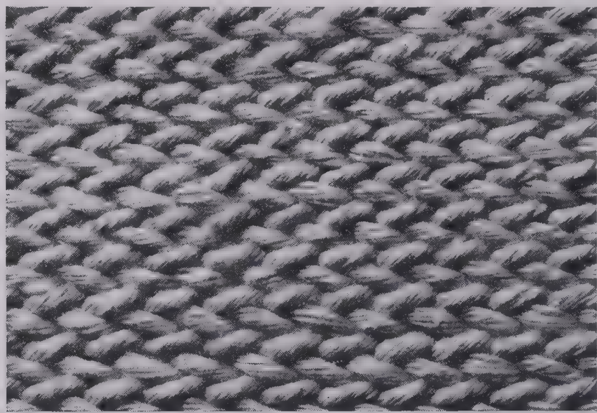

FIG. 311 'Countered' *compact 2-strand alternate-pair weft-twining.*

Alternate-pair weft-twining is sometimes combined with *plain weft-twining* to create a kind of patterning that suggests the use of floats in *interlaced* structures and has been described as 'skip-stitch twined weaving' (see fig. 312). Although presumably the device of twining the wefts round different numbers of warp units would not necessarily involve *alternate-pairing* of warps, all of the examples I have seen, or seen described, have been based on this formula.

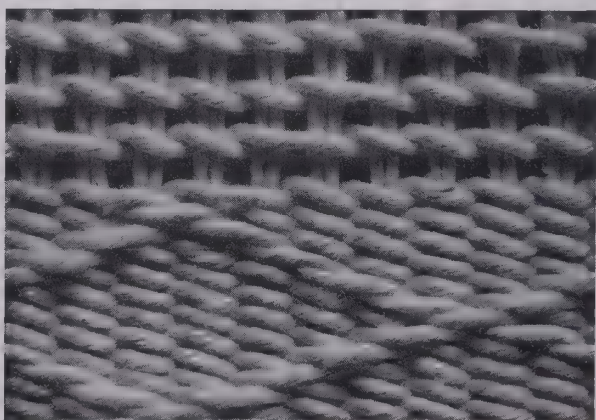

FIG. 312 *Alternate-pair weft-twining* combined with *plain weft-twining* to create a diamond pattern. Sometimes described as 'skip-stitch twined weaving.'

C. IN DEGREE OF TWINING-TWIST

FULL-TURN Plain *two-strand weft-twining,* in which (as in *warp-twining*) 'half-turns' bring each twining element alternately to each face of the fabric, can be varied by using 'full-turns' to keep each on its own face. Thus, when elements of different colors are twined together (see p. 200 for *warp-twining* equivalent), each color can be either retained on one face of the fabric throughout or exchanged with the other color to effect patterning. If the elements are alike in both flexibility and tension, each, although retained on one face of the fabric, will be visible on the other at each 'full-turn' (see figs. 313 and 314). But if one of them is rigid (as in the 'basketry' equivalent of 'full-turn twining,' see p. 210), or if the effect of rigidity is achieved by applying tension to a flexible element, the taut or rigid one will be visible on only one face.

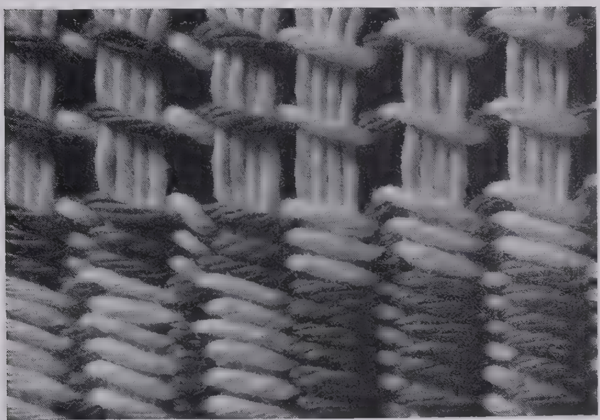

FIG. 313 Two-color *full-turn twining* on warp units comprising four warp elements each, showing how the 'full-turn' twining-twist retains a color on one face while the normal 'half-turn' of *plain twining* is used to change colors from face to face.

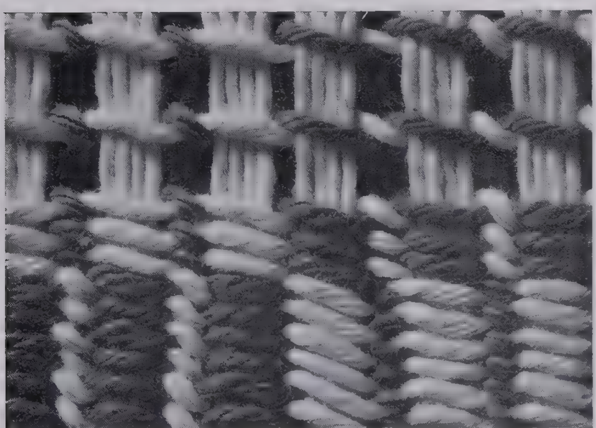

FIG. 314 Opposite face of the *weft-twining* in fig. 313, showing *identity* of structure with reverse of colors.

D. IN NUMBER OF COMPONENTS OF THE WEFT GROUP

MULTIPLE-STRAND When *weft-twining* is constructed with more than the necessary two *twining elements,* it corresponds exactly in structure to *multiple-strand warp-twining* (p. 199) but is somewhat less common and rarely involves more than three 'strands.' *Three-strand weft-twining,* like its *warp-twining* counterpart, has structurally *dissimilar* faces, on one of which (see fig. 315) the vertical ribbing is less clear-cut although the individual horizontal cords are heavier than on either of the *identical* faces of *two-strand twining. Three-strand twining* seems to have been used more for outlining (as in 'Chilkat blankets') and for edge cords than for large fabric areas.

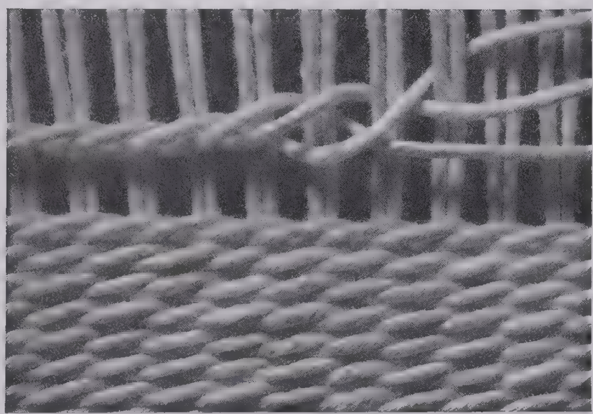

FIG. 315 A compact area of *3-strand weft-twining* with a diagrammatic construction of an individual cord of the same structure.

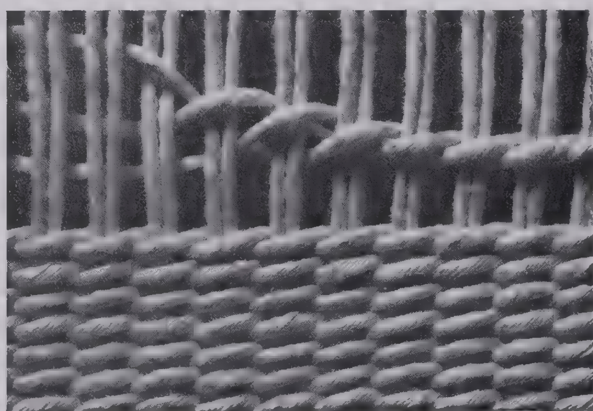

FIG. 316 Opposite face of fig. 315.

NOTE: that in a variant form of *three-strand twining,* usually described as 'braided,' the three strands are *interlaced* as well as *twined.* The appearance in a fabric is not distinctive, but if the foundation element were removed, a three-strand 'braid' would remain.

E. IN WARP MOVEMENT

Inasmuch as it is only when *weft-twining* is 'spaced' that the warps play a visually significant role, it is in that form that the possibilities of warp manipulation have been explored and developed. The manipulation consists almost entirely of shifting some or all of the warp elements out of their normal courses (parallel to each other and at right angles to the twining wefts). We have seen how, in 'spaced' *alternate-pair twining* (fig. 310, p. 202), the warps without being *crossed* over other warps are *deflected* from their parallel courses by being clasped by the twining wefts in alternate groupings much as, in *alternating float weave* (fig. 191, p. 114), warps are deflected by the alternate positions of the floats (see p. 189 for terms *transposed* and *deflected*). We have also seen how in *gauze weaves* (pp. 180 ff.) warps can be *crossed* over other warps and held in place by passages of weft; how in *transposed-warp weaves* (p. 188) certain warps or groups of warps can cross on extended diagonal courses over other warps which to a large extent maintain their normal positions; and how *supplementary warps* can cross in diagonal floats over areas of ground weave (p. 187). We find now, in 'spaced' *weft-twining*, such freedom of warp manipulation that the possibilities of warp movement are almost unlimited. The extensive range of variation would in itself make a comprehensive classification of all possible types difficult (and their enumeration impossible), but classification has been further hindered by the lack of accurate and systematic description of individual examples. Nevertheless, in the present study of available examples and descriptions, at least one basic distinction between kinds of warp movement has proved valid.

DIVERTED OR TRANSPOSED Warp elements, by definition (p. 74), are normally parallel to each other, and their directional trend is longitudinal. When warp elements are shifted from their parallel courses by being crossed over (or under) other warp elements, they are usually described generically as *crossed warps*; and in 'spaced' *weft-twining*, as in *gauze* and other *crossed-warp weaves*, they are secured in each successive order by the regular interworking of the wefts.

Perhaps the most fundamental structural distinction that can be made between different kinds of warp shifts in *weft-twining* is based on whether or not a positional interchange of warp units (or of components from different warp units) is involved. When there is no such interchange, that is, when certain warps cross over others that retain their normal positions and courses (figs. 317 and 318), the crossing is not equalized and the faces of the structure will be *dissimilar*, since the warps – better described as 'diverted' than as 'transposed' (see p. 189 for discussion of the terms) – are 'diverted' on one face (fig. 317) without equivalent movement on the other (fig. 318). But when warps are interchanged (probably a more common procedure), that is, when those diverted in one direction always cross others oppositely diverted (fig. 319), the *crossing*, which can be described as 'reciprocal' or 'compensatory,' is literally a *transposition*, and the faces of the structure will be *identical* since for every shift of warps on one face there will be a 'reciprocal' or 'compensatory' shift in the opposite direction on the opposite face.

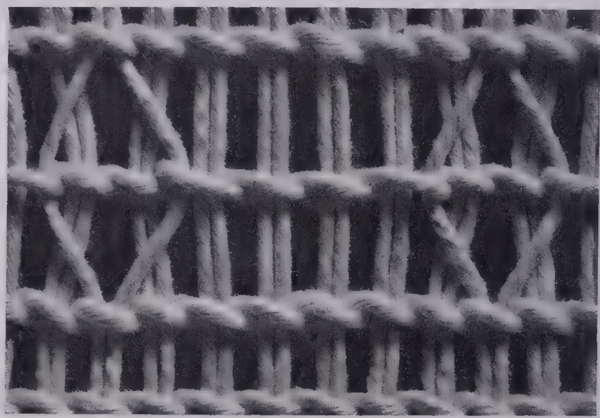

FIG. 317 Diagrammatic construction of unequalized crossing, or 'diversion,' of components of the regular warp units in *spaced 2-strand weft-twining* on paired warps.

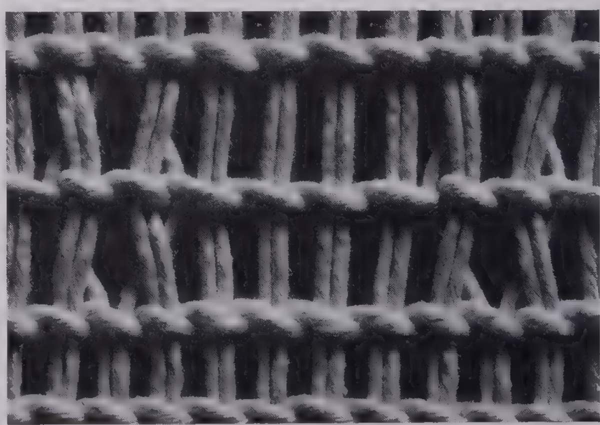

FIG. 318 Opposite face of fig. 317.

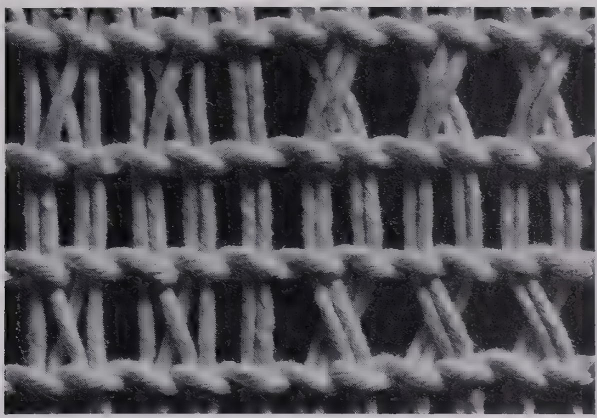

FIG. 319 Diagrammatic construction of 'reciprocal' or 'compensatory' *transposition* of adjacent warp units (and components of warp units) in *spaced 2-strand weft-twining* on paired warps. The opposite face is *identical*.

NOTE: that when warps that digress are *extra warps, supplementary* to a basic or ground structure, their action will not involve any displacement of the regular (ground) warps; it is seldom 'reciprocal'; and since it usually occurs on only one face of the fabric at a time, the two faces of the fabric are *dissimilar*. In fact, this use of *supplementary warps* differs from that in the 'diverted-warp patterning' of *interlaced weaves* (p. 187) only in the nature of the ground weave and the consequent manner in which the *diverted warps* are secured.

Obviously, warps are shifted from their parallel courses in order to create some kind of patterning, and a basic distinction can be made between the movement of warps when they are shifted in parallel zigzags, and that when they alternately diverge and converge (tending to produce diamond shapes). Obviously, too, it is the warps that cross in front of other warps on a given face of a fabric that build or carry the pattern on that face. When the shift of warps is not equalized by a compensatory shift of warps on the opposite face, there is patterning on only one of the necessarily *dissimilar* faces and every warp shift contributes to it (see fig. 317); but when the shift is 'compensatory,' the same pattern structure is produced concurrently on both faces although not necessarily directly superposed. On each face it is produced largely by the warps that cross in front of the reciprocal ones (fig. 319), and since the movement of the front-crossing warps is the same in both direction and extent on the two faces, the faces are structurally *identical*.

No attempt will be made here to enumerate the uncounted ways in which warp units can be divided, combined, re-united, moved from face to face, et cetera, and warp colors thus manipulated. It can be stated, however, that in *weft-twined transposed-warp* (and *diverted-warp*) structures, warp units are usually composed of pairs of warp elements. One of the pair may shift and not the other (fig. 319); the two components may shift in opposite directions (fig. 317); the pair may shift as a unit (fig. 319); and the extent of the shift may vary. The number of different ways in which components of certain warp pairs can be united with components of other pairs, and then either retained in the new pairing or returned to their original positions and pairs, is seemingly limitless; and the possibility of shifting color from face to face, as well as from place to place, contributes further variety. An additional structural elaboration is found in the 'spaced' *weft-twining* in which warps are not only *transposed* but are also *interlinked*, or *twined* with each other, as well as being secured by the *twining wefts*.

NOTE: that the use of floats, of either *transposed* or regular warps, although apparently not common, is obviously practicable and examples have been noted.

VARIANT USES OF WEFT-TWINING

'PILE' Either 'compact' or 'spaced' *weft-twining* can be used as other fabric constructions are (see p. 148) to secure tufts or flocks of wool or hair, or perhaps strands of yarn or fiber, thereby creating either a kind of shaggy 'pile' or decorative 'tags' according to the way they are spaced.

PATTERN As noted (p. 203), patterning possibilities in 'compact' *weft-twining* and the uses of *full-* and *half-turns* for color manipulation are comparable to those in *warp-twining*; in addition, discontinuous wefts of different colors can be used as they are in *interlaced weaves* to produce areas of solid color in the 'tapestry' manner. This is usually designated 'twined tapestry' and can be either plain or on alternately-paired warps ('twill-twined tapestry'). And in addition to the possibilities of warp manipulation found in 'spaced' *weft-twining* (involving *diverted* and *transposed* as well as *deflected warps*), there are almost unlimited possibilities of combining various kinds of 'compact' and/or 'spaced' *twining*.

Notes on the Use of Terms

Twining · Pairing · Cording

Fabric techniques that are less amenable to mechanization than *interlaced weaving* — techniques like *twining* and *wrapping* that have remained in part at least 'hand' or 'finger' constructions — have not been developed in as great quantity or diversity of standardized fabric types, and hence have not been subjected to such multifarious and diversified naming and re-naming. There are relatively few technical terms for the various forms of *twining*, and there is something surprisingly close to unanimity about the acceptance of the term *twining* itself as a designation of the type of fabric structure characterized by the turning of groups of two or more elements of the same set about each other to enclose successive elements of the opposite set. True, certain confusions have resulted from a lack of correlation between different areas of study — for example, the tendency (noted on p. 199) to equate *tablet-weaving* with *warp-twining*, and also (as noted below) the diversity of identification of twining variations in 'basketry' as opposed to 'cloth.' But in general, the term *twining* is definitive as a designation of a structural type and can be qualified, with little danger of misinterpretation, as 'warp-twining' when it is the warps that twine, and 'weft-twining' when it is the wefts.

NOTE: that the expression 'twined-plaiting' (or 'twine-plait') is somewhat tautological if it refers to *weft-twining* and the term *plait* is used to signify a 'finger technique,' that is, if the expression is meant to imply that wefts are twined by hand; and it is almost always ambiguous (see pp. 68 and 69) since it may be intended to denote, among other things, *oblique twining* (see p. 64) or *interlinking* (pp. 60 f.). The term *twined weaving* (or *twined weave*), on the other hand, is self-contradictory, unless the word *weave* is being used loosely to refer not specifically to *interlacing* but to any interworking of *weft* with *warp* elements.

Pairing is a term used only occasionally (and often rather informally) in reference to *twining*. Obviously only valid for *two-strand twining*, it seems also to be used solely in reference to *weft-twining*. It may have been selected in an attempt to distinguish the type of structure in which weft elements are used in pairs to enclose successive warp units (i.e. *weft-twining*) from *wrapping*, in which weft units are used singly with somewhat similar effect on one face (a technique sometimes rather ambiguously described as 'single twining'). But since the word *pairing* is not descriptive of the most significant characteristic of the *twining* structure — the turning of elements about each other — and since a fabric could not very well be said to be 'paired,' use of the term *pairing* for *two-strand twining* is very limited.

The term *cording*, on the other hand, cannot be as lightly dismissed. It seems to have been associated largely (but not exclusively) with *warp-* rather than with *weft-twining* and is descriptively applicable to two characteristic aspects of *twining* generally. The word *cording* may refer to the 'corded' (in the sense of heavily ribbed) appearance produced, especially in *warp-twining*, by the twining of two or more elements about each other; or it may refer to the fact that a *twined* fabric structure is, in fact, composed of series of 'cords' (connected by passages of elements of the opposite set) which are 'cords' in the sense of 'small rope' or 'twine'— that is, a variety of cordage characterized by more components and a more complex make-up than, for example, 'yarn.' The term *corded*, in the sense of 'ribbed,' is descriptively applicable to many *twined* fabrics; while in the sense of 'made up of parts having the structure of cords,' it is descriptively applicable to all *twined* fabrics. In the latter sense, however, the applicability is secondary, in that it rests on association — that is, the term *cord* refers to a type of structure to which components of the *twined* fabric structure can be compared — whereas the word *twining* refers specifically to the particular aspect of the *twined* fabric structure which makes its components comparable, structurally, to 'cords.'

NOTE: that the French *corde* can mean 'cord' or 'rope' and *corder* can mean 'to twist (hemp) into rope'; so that when a fabric is described in English as 'twined,' and the term *twined* is translated by the French *cordé*, there is a dual reference comparable to that implied by the use of the term *corded* in English.

Twining: Compact · Spaced · Openwork

The terms *compact* and *spaced*, when used in reference to *twining*, speak for themselves; and 'close-twined,' apparently the only equivalent for *compact twining* in general use, is equally self-explanatory. But the expression 'twined openwork' (or 'openwork twining') is not a synonym for *spaced twining* (as often seems to be assumed) although it may be descriptive of certain examples of the structure. That is to say, 'spacing' in *weft-twining* (*warp-twining* is always *compact*) does not necessarily produce 'openwork.' In reference to *twining*, the term *spaced* is used in the sense of 'set at some distance apart' and refers to the distance between successive rows (or courses) of twining elements. Whether or not a *weft-twined* fabric in which the *twining* is *spaced* is an 'openwork' fabric will depend in part on the 'spacing' of the warps. If they are closely contiguous, neither the structure nor the fabric can be properly described as 'twined openwork,' although the *twining* itself is quite properly described as *spaced*. So, when we consider the fact that *oblique twining*, too, can be used for either a 'close-worked' or an 'openwork' fabric, we are forced to conclude that although the terms *twined openwork* and *openwork twining* have some descriptive value, their structural connotations are at best vague.

Twining: Twill · Diagonal · Split-pair · Alternate-pair

Although most terms for varieties of *twining* structures are descriptive of appearances – of 'visual effects'– they are, nevertheless, often used to designate specific structures. The terms *twill twining* and *diagonal twining* are frequently used (although with questionable validity) to distinguish *twining* (particularly 'compact') in which the non-twining elements are paired alternately by each successive group of twining elements from that in which the non-twining elements are used in unvaried units throughout. Whereas the latter produces series of more or less pronounced ribs or wales extending in the direction of the concealed non-twining elements (i.e. warp-wise in *weft-twining*, weft-wise in *warp-twining*), in the former the alternation of twining points sometimes produces an appearance which suggests the diagonal alignment of floats in an *even twill weave*, and it was undoubtedly this appearance that led to the use of the terms *twill twining* and *diagonal twining*.

Use of the term *twill twining* is sometimes defended on the grounds that the relationship between *plain twining* (i.e. with unchanging units throughout) and *alternate-pair twining* (in which the units constantly change) suggests the relationship between *plain weave* (over-1-under-1) and *2/2 twill weave* (progressively over-2-under-2). But the analogy proves invalid for a number of reasons. In *twill weave*, for example, the effect of diagonal ribbing is produced by a stepped progression in the interlacing, either to the right or to the left, with the direction of the diagonal thus formed reversed on the opposite face. But in *alternate-pair twining* there is no one-direction progression; there is simple alternation (which has no direction), and whatever visual suggestion there is of a diagonal in one direction rather than the other results from the slant of the twining elements in relation to the non-twining, which is in turn determined by the direction of the twining-twist and is the same on both faces. On the other hand, when it is argued that *plain weave*, being 'complete on two wefts,' is comparable to *plain two-strand weft-twining* in which a single row, requiring two wefts, is repeated without change, and that *2/2 twill*, being 'complete on four wefts,' is similarly comparable to *alternate-pair weft-twining*, which requires two rows of *two-strand twining* (2 wefts each) to establish the structure, the fact that in neither case are the warp requirements comparable (being respectively, 2 and 4 in *interlaced weaving*, 1 and 2 in *twining*) is either not noticed or is not mentioned because it would invalidate the argument.

Obviously, when used only in reference to the 'compact' forms of *twining*, the term *twill twining* is deceptive unless it is clearly used without structural connotations, while the term *diagonal twining* has little to recommend it except as a purely descriptive designation when the effect of diagonals is marked. But use of either term in reference to the 'spaced' forms of the same structure – which would be the logical procedure and unavoidable if they designate specific structures – cannot be justified. *Twill-twining* would not be applicable even descriptively, since there is nothing in the appearance of the 'spaced' form to suggest *twill* weaving; and *diagonal twining* would be misleading in a curious way, since the only diagonals to be seen in 'spaced' *alternate-*

pair twining are not in the *twining* but in the zigzag courses of the deflected warps (fig. 310, p. 202). 'Spaced' *alternate-pair twining* is, in fact, often identified, and differentiated from other *weft-twining*, as 'zigzag twining'; but since the term *zigzag twining* suggests that the twining itself forms the zigzags, it should be reserved for examples of *twining* (usually in the form of relatively narrow bands) in which *twining wefts* move first on one diagonal and then the other back and forth across the full width of the warp.

The term *split-pair twining* is used chiefly — if not solely — in reference to *weft-twining*. It is graphically descriptive of the actual *alternate pairing* of warps in *weft-twining* (in which the warps that are paired by the twining wefts in one passage are separated and re-paired in the next) whether the twining is 'spaced' or 'compact,' but it is descriptive of appearance only if the twining is 'spaced' and seems inappropriate to *warp-twining*, which is necessarily quite differently constructed and is never 'spaced.' Applicability of the term *alternate-pair twining* is not similarly restricted, since it describes specific structural characteristics regardless of method or appearance. It applies whether the structure is 'spaced' or 'compact,' to *warp-* as well as to *weft-twining*, and will serve to designate the same structure wherever found and however used.

Basketry · Cloth

Almost everyone has a quite definite but often ill-defined concept of each of these terms. There are many fabric forms and textures that are widely recognized as 'basketry' and many others commonly known as 'cloth,' but the reason for putting a specific fabric or texture in one category rather than the other is usually extremely vague.

In discussions of 'cloth' or cloth weaving, there is seldom occasion to refer to 'basketry' but in most discussions of 'basketry' comparisons are made between 'basketry' and either 'cloth' or 'weaving'; and some attempt is usually made to prescribe grounds on which to distinguish between them. The terms *basketry* and *cloth* are both widely used as generic terms for large groups of fabrics, and, obviously, it is usually assumed that the groups to which they refer are more or less distinct although the assumed line of demarcation is seldom either clear or consistent. Each of the terms is variously defined and the fabric type to which it refers delineated in various ways.

It is easier, of course, to distinguish a basket from a piece of cloth than to define the delimiting characteristics of either term, *basketry* or *cloth*. *Basketry*, as Mason has pointed out (1904, p. 193), is a general term applicable both to the products of 'basket making' and to its processes and techniques; whereas the term *cloth* is only applicable to the products of cloth-making, although it, too, is a general term since the concept of cloth-making is general in that it is not restricted to particular structures or materials.

NOTE: that a distinction is sometimes made between 'basketry' and 'weaving' instead of between 'basketry' and 'cloth'— the term *weaving*, like *basketry*, being applicable to both process and product. But this distinction is complicated by the fact that since 'basketry' is acknowledged to be of two major kinds, 'woven' and 'sewn,' the distinction between 'basketry' and 'weaving' usually proves to be only a distinction between 'woven basketry' and 'woven cloth.'

If it is the product — the fabric type — rather than the type of construction that is being differentiated, then the question is: what characteristics serve to differentiate the results of basket-making (i.e. *basketry*) from the results of cloth-making (i.e. *cloth*)? A survey of definitions shows that, according to most of them, *cloth* as a generic term refers to any fabric ('fibrous' is usually implied) made by any process — weaving, knitting, netting, looping, even felting — and of practically any fiber —'wool, hair, cotton, flax, hemp, or other vegetal filaments.' (For certain limited and specialized uses of *cloth*, as a specific term, see pp. 85 f.)

Quite naturally, the popular concept of 'cloth' is affected by its many everyday uses, and definitions of the term are frequently qualified by reference to them —'for garments,' 'for garments and other covering,' or 'suitable for wrapping, spreading over, etc.,' for example. Surprisingly, however, pliability, a quality implied in all the stated uses of 'cloth' (and one which is significant in differentiating 'cloth' from 'basketry') is seldom mentioned. In fact it seems to be assumed that the concept of 'cloth' is so widely accepted that it needs little elucidation. Definitions usually only state that 'cloth' is a 'fabric' or a 'textile fabric' or a 'stuff,' 'texture,' or 'material,' made in any number of ways out of any number of different fibers

and filaments. The statements are usually broadly inclusive – placing little or no specific limitation on the range of application of what is obviously accepted as a very general as well as a very familiar term.

It is chiefly in differentiating 'basketry' from 'cloth' that certain limits to the applicability of the term *cloth* are actually stated and a distinctive nature ascribed to the fabric it connotes. And it is usually only as criteria for differentiating 'cloth' from some other type of fabrication like 'basketry' that mention is made of processes both of element-preparation and of fabric-construction, as well as specific qualitative characteristics of 'cloth'– the use of spun or twisted fibers, for example, or of 'softer' or 'finer' fibrous materials, the concomitant use of a loom or perhaps even a 'frame,' or the planar nature (the typical 'plane surface') of *cloth*. By compiling and appraising the numerous and varied statements about the differences between 'basketry' and 'cloth' we find a variety of criteria for distinguishing them, notably: 1) implementation ('manual' production as contrasted with the use of 'devices'); 2) preparation of the elements (spinning or twisting); 3) their relative size, flexibility, et cetera; and 4) the shape and quality of the finished product. Sometimes a single criterion, sometimes a number of them – in some or all of these categories – are considered requisite to differentiation (but it should be noted that the structure of the fabric is seldom adduced as a basis for distinction).

In practice, all of these criteria prove useful in distinguishing certain types of *basketry* from certain types of *cloth*; but none is generally applicable to all types of both. Lack of implementation is often cited as the single proper basis for determining what shall be classified as 'basketry,' but proves unsatisfactory when applied to many 'braided,' 'looped,' 'netted,' and other fabrics which anyone would hesitate to call 'basketry' even though the construction is known to be almost wholly manual, or to the 'Chilkat blanket,' the 'Maori cloak,' and other *weft-twined* 'cloth-like' fabrics which are often implemented simply by some means of suspending the warp elements. Conversely, we find that although 'matting' is usually recognized as a form of 'basketry,' it is produced in some parts of the world on what is for all practical purposes a loom, that is, on a frame with a simple but effective device for forming sheds. It is plain that too much of the construction of what is thought of as 'basketry' is 'implemented,' and too much of the construction of cloth-like fabrics is not, for 'lack of implementation' to serve as a criterion for disjunctive classification – quite aside from the basic fact that any classification based on means of production breaks down when the means of production cannot be determined.

Another frequently proposed basis for distinguishing between the two fabric types is the nature of the elements. The presence or absence of spin or twist in the make-up of the elements may be deemed the essential point of differentiation by some, while others find the relative size and flexibility of the elements the distinctive feature. (Some simply specify certain fibrous substances such as 'reeds, grasses, etc.' as the materials of which basketry is made and then imply or state that anything made of that material is an example of 'basketry.') However, these criteria also prove unsatisfactory in specific instances. If the use of unspun fibers is a mark of 'basketry,' what of the delicate cloth-like fabrics woven of shredded pineapple fiber (*piña*) or some of those woven of raffia – not to mention the fact that silk, one of the primary 'textile fibers,' is often used unspun? And if the size and flexibility of the elements determines the classification, where can the line be drawn between degrees of these almost infinitely variable qualities which apparently cannot even be described with any precision but must be expressed as comparatives –'harder,' 'more rigid,' 'broader,' for *basketry*; 'softer,' 'finer,' 'more flexible,' for *cloth*?

Still another suggested criterion concerns form or shape in a fabric and is related to use –'basketry' often being associated with 'receptacles' and 'cloth' with 'flat surfaces.' But inasmuch as bags are as much 'receptacles' as 'baskets' and yet are often qualitatively closer to the general notion of 'cloth'– if, indeed, not actually loom-woven – and, conversely, since mats are by nature 'flat surfaces' although seldom if ever associated with 'cloth,' this criterion too proves inadequate. However, when the compass of the distinction is extended to include 'pliability'– or lack of it – and the amount of inflexibility considered necessary for a fabric to be classed as 'basketry' is specified, the criterion is more valid. Holmes (1896, p. 15), for example, specified "sufficient rigidity to retain definite or stable form without distension by contents or by other extraneous form of support."

We must conclude, it seems, that although the

common concepts of both 'basketry' and 'cloth' cannot be disregarded, they are variable composites, compounded of qualities and characteristics whose relevancy and application vary with the fabrics under consideration; and this being so, we must further conclude that any distinctions between 'basketry' and 'cloth' will inevitably also be qualitative — and equally variable. However, it is partly because so much fabric classification rests on just such variable assemblages of rather indefinite criteria that the classification being formulated in this volume is based wholly on structure — structural relationships and structural distinctions — and a comparison of the structures of 'basketry' and 'cloth' shows that while parallels are extensive, few distinctions can be made. Indeed, it would seem that the only structures that could be clearly differentiated from 'cloth' and classed separately as 'basketry' structures would be those that, as structures, require some inherent rigidity of elements (i.e. structures in which tension cannot be substituted for rigidity and which are therefore limited to certain types of fibrous material; such structures cannot be duplicated when wholly flexible elements are employed).

Obviously, this does not solve the problem of how to define the distinction between 'basketry' as one fabric type and 'cloth' as a wholly different one. It indicates instead that a problem only arises because of what proves to be a false assumption, the assumption that the terms *basketry* and *cloth* refer to mutually exclusive groups of fabrics. Both terms are broadly generic and actually refer to fabric groupings that overlap in so many areas that neither group can be properly studied or understood without reference to the other. The relationships between them are far more numerous than the differences, and while it is often easy to distinguish individual examples as one rather than the other, separation of the two groups is necessarily arbitrary. The habit of treating them as disparate subjects for investigation has led unhappily to the use of different terms for identical structures as well as to frequent failure to recognize and record structural identity or similarities in closely related fabrics that happen to have been relegated to separate categories. Much information which would be useful and should be available for studies of the development and distribution both of techniques and of structures has thus been misplaced or fragmentized, and often invalidated.

So although it seems futile to try to draw a clear line of demarcation between 'basketry' and 'cloth' (or between 'basketry' and 'weaving,' or 'basketry' and 'textiles,' or even between 'basketry fibers' and 'textile fibers'), there is no doubt that the nature of the materials employed affects the nature and the use of a fabric in various ways and that when inflexible or only slightly flexible elements are employed, the nature of the fabric will necessarily differ from that of one composed of pliable elements. With this in mind, it would seem reasonable as well as practical to conclude that 'basketry' in general comprises fabrics which, due to the inherent inflexibility of some or all of their component elements, have little or no pliability; while in 'cloth' there are no inherently rigid or inflexible elements, and such inflexibility as might be imparted to a fabric wholly by the manner in which flexible elements are manipulated would not change its status as 'cloth.'

Twining: Wrapped · Bird-cage · Lattice · Crossed-warp

In this volume no structures have been illustrated which are used solely in 'basketry' and, as stated on page 56, "The basketry terms that are used are largely terms whose applicability is not restricted to basket-work. . . ." But there are certain fabric structures which, presumably because they are frequently constructed with one or more sets of rigid elements, are best known as 'basketry' structures and as such are designated by terms that are not used when there are no rigid elements (or when tension is substituted for rigidity). For example, so-called 'wrapped' or 'bird-cage' *twining* is structurally *full-turn twining* (see p. 203), and the terms *wrapped twining* and *bird-cage twining* are restricted to 'basketry' usage because, by definition, they refer to structures requiring 'two sets of rigid elements at right angles to each other.' (Note that 'wrapped' or 'bird-cage' *twining* is sometimes described as having two sets of rigid 'warp' elements at right angles to each other, but it is more readily understood as a structure with one set of rigid warp elements and two sets of transverse, or weft, elements — one rigid, the other *twining* about it and 'wrapping' the crossings of rigid warp with rigid weft.)

So-called 'lattice-twining' by definition also requires two sets of rigid elements and consequently is classified as a basketry technique. It differs from

'wrapped' or 'bird-cage twining' in requiring two flexible *twining* elements. In its usual form it has rigid vertical (or warp) elements and three sets of transverse (or weft) elements, one of which is rigid and is held in place at right angles to the warp by the two flexible ones; but when the warps in 'crossed-warp twining' (v.i.) are rigid, it too is sometimes described as 'lattice-twining' although it seems to be more customary to qualify this form as 'diagonal' or 'oblique' *lattice-twining*.

Certain receptacles and other objects require some rigidity in the elements that compose them in order to effect and retain a proper shape, but firmness or inflexibility is seldom essential to the structure itself. However, for a *weft-twined* fabric in which there are no vertical elements, that is, one in which all non-weft elements are oblique and alternate ones proceed on opposite diagonal courses but do not interlace with each other – being secured solely by the twining action of successive pairs of *twining wefts* – the structure as a structure requires foundation (or 'warp') elements with a certain amount of inherent rigidity. Thus it is, primarily, a basketry structure, one usually described as 'crossed-warp twining' and said to have two sets of 'warps' which are differentiated by their directional trend. The structure can, it is true, be satisfactorily employed in limited areas of *weft-twining* with the customary vertical warps and no rigid elements – but so used it is clearly a form of regular *weft-twining* with reciprocally *transposed warps* (see pp. 204 f.).

NOTE: that one of the patterning devices typical of *basketry* but not of *cloth* is that sometimes described as 'false embroidery.' It consists of the embellishment of a *weft-twined* fabric during the twining process by means of additional elements which are wrapped round each twining element as it comes to the surface or 'right' side of the fabric, and which do not appear on the reverse.

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Symonds and Preece, 1928
Underhill, [1945]
Vogt, 1937, 1947
von Walterstorff, 1925
Wardle, 1936
Weibel, 1952a
Weltfish, 1930
Wheat, 1954
Wilder, 1951
Willey and Corbett, 1954
Willoughby, 1905, 1910, 1917, 1922, 1938a, 1952
Wilson, 1933
Wormington, 1947
Wyman, 1935
Yacovleff and Muelle, 1932
Zingg, 1940

PART TWO

Classification of the Structures of Fabrics

- I Felted Fibers
- II Interworked Elements
  - A. Single Element
  - B. Two Single Elements
  - C. One Set of Elements
  - D. Two or More Sets of Elements
    - 1. Interlacing warps and wefts
    - 2. Interacting elements
    - 3. Wrapping wefts
      (*see below*)

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3. WRAPPING WEFTS

- a. Simple structures
  - 1). Plain weft-wrapping
    - Variation: of 'stitch' orientation
      - 'Countered'
      - 'Turned'
    - Variation: of sequence and spacing
  - 2). Knotted-weft wrapping
- b. Compound structures
  - 1). Plain extra-weft wrapping
    - Variations
  - 2). Extra-weft pile wrapping
    - a.) So-called 'pile-' or 'rug-knots'
      - Ghiordes (or Turkish) 'knot'
      - Sehna (or Persian) 'knot'
      - Single-warp (or Spanish) 'knot'
    - b.) Some presumably developmental forms

NOTES ON THE USE OF TERMS

Wrapping • *Wrapped weave* • *Soumak wrapping*
Knot • *Knotted wrapping* • *Knotted-pile* • *Pile-knots* • *Rug-knots*
Names of so-called 'rug-knots':
Ghiordes • *Smyrna* • *Sehna* • *Spanish* • *Coptic*

SOURCES OF INFORMATION

3. Wrapping Wefts

In both large general groups of fabric structures that have been discussed – those composed of *two or more sets of elements* and characterized either by *interlacing* between the elements of different sets or by *interacting* of elements of the same set – the progress of all elements either across or along the fabric is generally speaking unchanging and uninterrupted. There is, however, a third group composed of structures in which the progress of weft across warp is repeatedly broken; that is, the movement of the weft is alternately forward and back. This involves a quite different spatial relationship between elements of the two sets, namely a progressive encircling, or *wrapping*, of warp- by weft-elements. The repeated reversal of the direction of weft movement does not, however, materially affect either the essentially parallel relationship between elements of the same set or the essentially right-angled relationship between those of opposite sets. Since, in order to progress across the web, the *wrapping weft* must always move farther forward than it moves back (see fig. 320), the span of the forward movement is necessarily greater than that of the backward one. Thus the two faces of the *wrapping* structure are *dissimilar*, and if the forward movement is always on the same face of the fabric, the two faces of the fabric will be *dissimilar*.

FIG. 320 Basic structure of progressive *weft-wrapping*: over two warp units and back under one.

NOTE: that although the *wrapping* structure itself has structurally *dissimilar* faces, faces that appear to be *identical* are produced in a *weft-wrapped* fabric when, with each passage of the weft, the *wrapping* structure is 'turned' (see fig. 325, p. 216).

In the 'openwork' use of *plain-weave interlacing* noted on page 84, *weft elements* move across the *warp* in an intermittent progression that is somewhat comparable to that of progressive *wrapping* – that is, by alternately moving forward a certain distance and then back at least half as far. But whereas an *interlacing weft* moves both forward and back in essentially the same plane with the warp it interlaces, a *wrapping weft* moves (without interlacing the warp) in two planes – one above and one below the warp. This gives the fabric a 'two-layer' or 'two-ply' quality not found in *simple interlacing* but comparable instead to that imparted by the paired wefts of *two-strand weft-twining* (see p. 196), in which one weft lies above any given warp unit and the other below. *Weft-wrapping* is comparable to *weft-twining* also in the slightly oblique angle at which each forward moving weft crosses each warp unit (see fig. 321). In fact, if the forward movement is always on the same face of the fabric, the appearance of that face of *weft-wrapping* will be very similar to (sometimes almost indistinguishable from) either of the *identical* faces of *compact two-strand weft-twining* (fig. 305, p. 201). However, in *wrapping*, it is the fact that successive forward movements of the weft necessarily overlap that is responsible for the oblique-angled relationship of *wrapping wefts* to the warp (fig. 321); the backward movements are contiguous and essentially at right angles to the warp, although some indication of slant can often be detected (fig. 322).

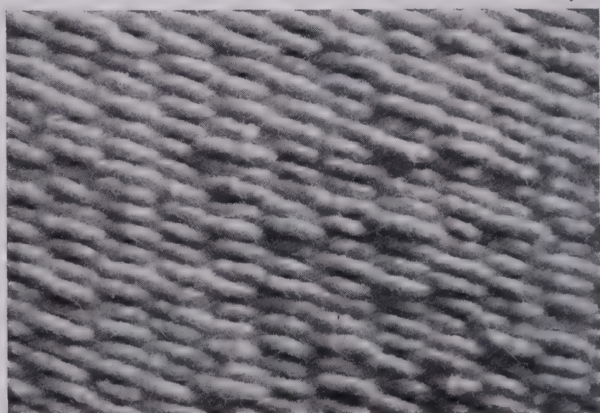

FIG. 321 One face of *plain weft-wrapping*, showing the long, progressively overlapping, forward movements of the *wrapping weft*. Opposite face of fig. 322.

NOTE: that it is only if the weft, in addition to encircling a warp unit (or units), passes through a loop of its own part that a *knot* (see p. 34) is formed and the weft action can be properly described as *knotting* rather than as *wrapping*. Thus most of the so-called 'rug-' or 'pile-knots' (pp. 221 ff.) are actually formed by *weft-wrapping*.

A. SIMPLE STRUCTURES

Wrapping, like *twining*, is a 'hand' process which does not lend itself to mechanization. *Wrapping wefts* can be used in two ways: as the sole weft elements of a *simple* (one warp, one weft) structure; or as extra wefts, *supplementary* to a (usually *interlaced*) ground weave in a *compound* structure. That is to say, *wrapping wefts* will serve adequately as the one-set-of-wefts of a *simple* fabric structure if, in their progress across the warp, they leave no warp elements unencircled; but if the system of *wrapping* is such that certain warp elements are not encircled (if, for example, *wrapping wefts* consistently move back less than half the distance they move forward) a ground-weave structure will be requisite to a coherent fabric.

1. PLAIN WEFT-WRAPPING

In the simplest and clearly the basic form of *weft-wrapping* (see fig. 320), there are only two weft movements. Weft elements repeatedly cross first over (or under) two or more warp units, then back under (or over) half the number (one or more), thus progressively encircling, or *wrapping*, all warp elements one or more at a time. This particular weft action is comparable to the *horizontal wrapping* on vertical foundation elements described on page 54 (see fig. 64) and to 'stem stitch' (q.v.) in embroidery, but is so widely associated with the 'flat-woven' rugs known as 'Soumak' ('Soumakh,' 'Summak,' etc.) that the term *Soumak wrapping* has come to be fairly definitive as a designation of the basic over-2-and-back-under-1 (or over-4-under-2, etc.) use of *wrapping wefts* wherever found (see p. 225 for use of the term). In Soumak rugs, the *wrapping wefts* are *supplementary* to an *interlaced* ground weave (see p. 218) and are often discontinuous, as in *tapestry weave*, but the *wrapping* structure itself is the same as when it is used without a ground weave in *simple* fabric structures.

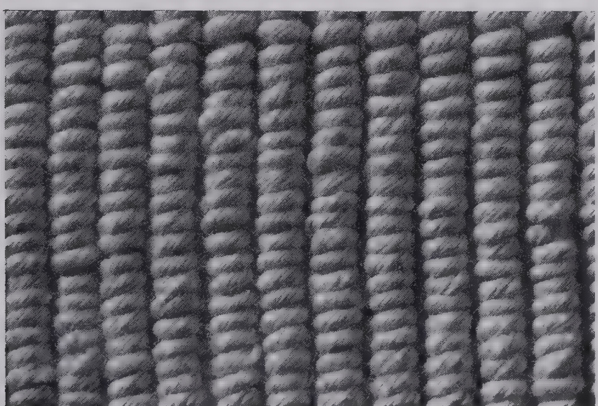

FIG. 322 Opposite face of fig. 321, showing the shorter return movements of the *wrapping* wefts.

VARIATION: of 'stitch' orientation

'COUNTERED' In *plain weft-wrapping* the direction of slant of the overlapping spans of forward-moving weft is often reversed in successive rows (i.e. 'countered'), producing an effect on one face of the fabric (fig. 323) similar to that in 'countered' *compact weft-twining* (fig. 307, p. 201). But in contrast to the *identical* faces of 'countered' *weft-twining*, only one of the faces of 'countered' *weft-wrapping* affords visual evidence of this alteration of the wrapping procedure (compare figs. 322 and 324).

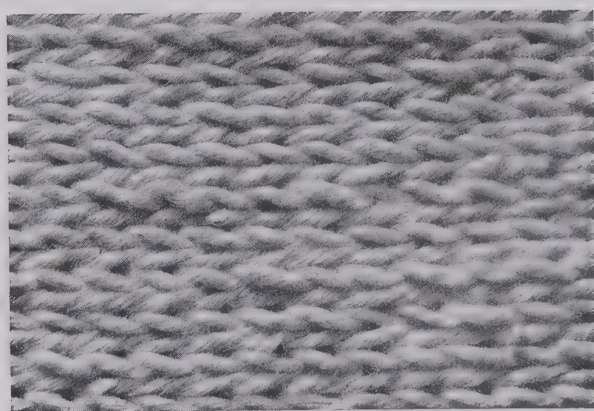

FIG. 323 One face of 'countered' *weft-wrapping*, with the slant of the long weft span reversed in successive weft passages. Opposite face of fig. 324.

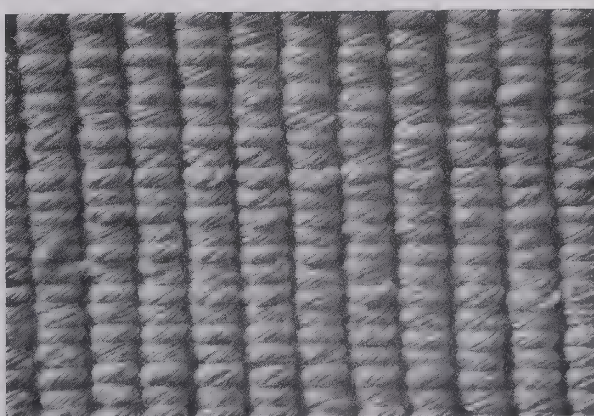

FIG. 324 Opposite face of fig. 323, showing how little the reversal of the slant of the long weft span on one face affects the appearance of the short return movement on the other.

'TURNED' We have noted (p. 214) that, although the span of the *wrapping weft* is necessarily longer on one face than on the other, it is possible – by constantly 'turning' the *wrapping* structure (i.e. reversing the face, as in fig. 325) – to produce a *weft-wrapped* fabric with *identical* faces. Since the *wrapping weft* constantly overlaps itself on one face (fig. 321) but not on the other (fig. 322), this 'turning' of the *wrapping* structure has the advantage of balancing the structure of the fabric by distributing the weft evenly between the two faces – an advantage which may account for the rather wide-spread use of this device when a fabric is constructed with *wrapping wefts* only, without a ground weave.

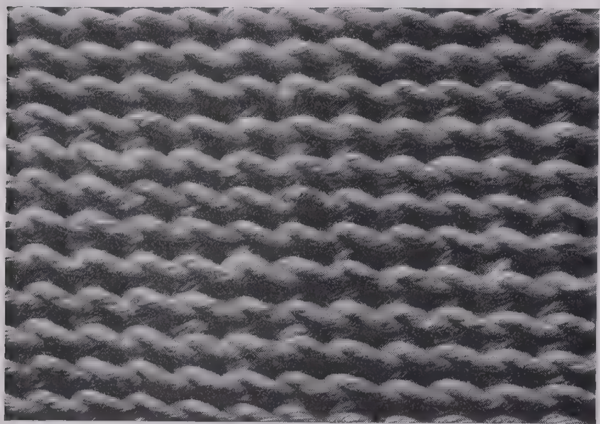

FIG. 325 'Turned' Soumak-type *wrapping*. The face of the *wrapping* structure is reversed in each successive weft passage. The faces of the fabric (but not of the stitch) are *identical*.

FIG. 326 A variation of *plain weft-wrapping* in which the forward movement in alternate rows (e.g. *a*) is under-1-over-2-under-1 warp, the movement back, over-2 warps. The opposite face of each *wrapping* row is structurally *dissimilar*.

VARIATION: of sequence and spacing

Simple weft-wrapping (without a ground weave) is comparable to *weft-twining* in having neither need nor use for either heddles (to produce sheds) or shuttles (to carry the weft); and thus, like *weft-twining*, the *weft-wrapping* structure can be widely and freely varied. Not only is it possible to reverse the direction of the slant of the weft overlap and/or the face of the *wrapping* structure; but in addition, the sequence of orders and extents of the over-and-under and forward-and-back movements by which the *wrapping weft* progressively encircles warp elements can be almost endlessly varied – as long as no warp elements are omitted from the wrapping action.

For example, according to a published description and diagram (Heizer and Johnson, 1952), in a prehistoric *weft-wrapped* sling from Lovelock Cave, Nevada, the forward movement in one passage of the weft is under-1-over-2-under-1 warp, the backward movement, over two warps (see fig. 326, *a*). Since, if constantly repeated, this (even more than *plain weft-wrapping*) would put an over-balancing amount of the weft on one face of the fabric, it is not surprising to find the faces of the *wrapping* reversed (i.e. 'turned') from passage to passage. But it is rather surprising to note the relationship of this form of *wrapping* to that used to construct the Ghiordes, or Turkish, 'rug-knot' (see p. 221) and to realize that if the *wrapping weft* were cut midway in each forward movement, there would be a series of cut 'pile-knots' which might be quite indistinguishable from Ghiordes 'knots' (although a ground weave would be necessary if the *wrapping wefts* were cut).

In some variant forms of *weft-wrapping* the passages of weft are 'spaced'; some involve *interlacing* as well as *wrapping*; and in some, *wrapping wefts* wrap other wefts as well as warps. For example, many of the (often embroidered) square-meshed openwork fabrics from ancient Peru (those usually described as 'having square openings,' as 'imitation filet,' or as 'two-thread filet') do not, as do those shown in figures 329 and 330 (p. 218), involve actual *knotting*; instead, the crossings of warp and weft pairs are secured only by the *wrapping*, or by combined *interlacing* and *wrapping*, of one of each pair of wefts (a *wrapping weft*) about the other (an *interlacing weft*) as well as about each successive warp pair intersected. Presumably the word *filet* has been used because the openwork meshes are usually square – as in *single-element* 'filet' (see p. 39) – and the word *imitation*, because the meshes are formed not by a *single element* but by 'spaced' pairs of weft

crossing equally-spaced pairs of warp. The expression 'two-thread' may refer to the fact that there are two sets of elements involved – warp and weft – or to the fact that both warp and weft elements are used in pairs. (When the pairs of warp are repeatedly split and re-paired, the openings tend to be triangular and the word *filet*, which in English refers to square-meshed *knotted netting*, is not applicable.)

There are also varied examples of the *weft-wrapping*, usually described as *weft-wrap openwork* (see p. 85), in which wefts wrap other wefts as well as warps. The openwork is combined with *plain weave*; *plain-weave wefts* become *wrapping wefts* from time to time to create the openwork and then continue in *plain weave*. The general appearance suggests drawn-work.

2. KNOTTED-WEFT WRAPPING

If a *wrapping weft* not only encircles successive warps or warp groups but 'ties' each encirclement by passing through a loop of its own part, the structure produced is a form of *knotted-weft wrapping*. When *wrapping wefts* are *knotted* round the warps at each warp-weft intersection, the intersections can be more firmly 'fixed' than by *wrapping* alone – or even by *wrapping* combined with *interlacing* – making it possible to 'space' the passages of *wrapping wefts* more effectively and to construct meshes of fixed dimensions. In fact, *knotted-weft wrapping* seems to serve largely as a means of producing, on a loom, and with two differentiated sets of elements, fabrics having the fixed-mesh characteristics of *single-element knotted netting* – thus providing a means of combining knotted openwork with other loom structures in one fabric. The meshes of loom-made *knotted-weft wrapping* are rectangular if the wefts knot about the yarns one at a time, or if the same warp groups are repeatedly knotted together. The meshes are more or less triangular if warps are alternately paired, or grouped, and re-paired, or re-grouped (see fig. 327). The knot is usually some form of *simple knot* (see fig. 328, for example, and p. 34).

In ancient Peru – where the major evidence of use of this particular type of structure has been found – the structural principle of loom-made *knotted-weft openwork* was applied in a variety of ways, and fabrics constructed on that principle were produced in a variety of textures and qualities. The structures are of two general types, of which the one illustrated in figure 327 is structurally the simplest. It is known to have been used in at least two basically different ways: 1) as a monochrome openwork background for *tapestry-woven* patterning; and 2) for all-openwork fabrics patterned by correlated color changes in both warp and weft (with both warps and wefts discontinuous and interlocked). But in either use the warps are apparently consistently paired and re-paired, forming triangular meshes, the warp dimensions of which are considerably greater than the weft. (The warp count is usually much higher than the weft count.)

The second general type of *knotted-weft wrapping* is closely related to the square-meshed *wrapped* openwork described on page 216. Both are characterized by the use of 'spaced' pairs of weft, one a *wrapping weft*, the other an *interlacing* one, interworking at intervals with 'spaced' pairs of warp. The

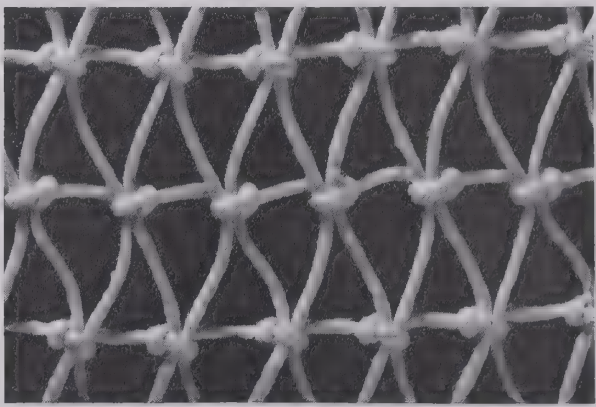

FIG. 327 Loom-made *knotted-weft wrapping* used for a triangular-meshed openwork structure. Spaced wefts are knotted about two warps at a time, and the warps are re-grouped in each successive *weft-knotting* passage.

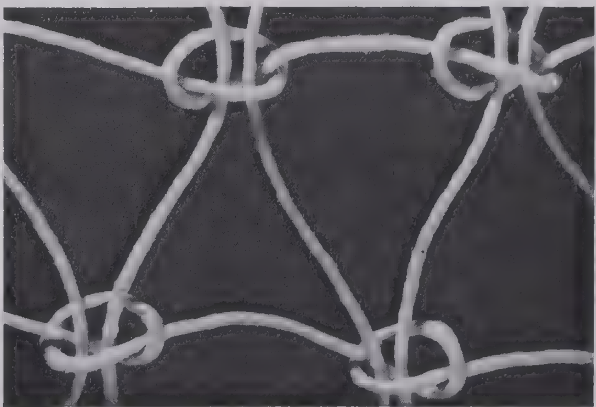

FIG. 328 Diagrammatic construction of the *knotted-weft wrapping* in fig. 327, showing the structure and alternate tying of the *simple* weft-knots, as well as the alternate pairing of warps.

knotted structure, in which the *wrapping weft* actually forms a *simple knot* round both its companion weft and the two warps, at each intersection of weft-with warp-pair, is often difficult to distinguish from the unknotted form, unless the intersection can be loosened for identification. But in spite of considerable similarity in the general appearance of all of these usually square-meshed fabrics, it is difficult to find two in which the *wrapping weft* shows exactly the same interworking sequences; and all the intersections in any given fabric are not necessarily identically secured. One of each pair of wefts is always an *interlacing weft*; but in some examples, the second (or *wrapping*) *weft* wraps and knots round the other weft and each pair of warps (e.g. fig. 329); in certain others, the *wrapping weft* also *interlaces* the pair of warps (e.g. fig. 330); and so on.

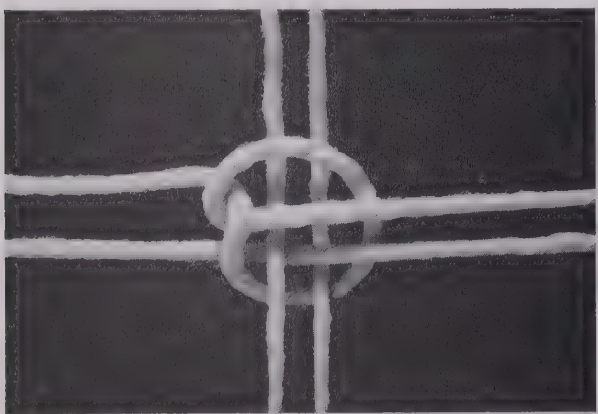

FIG. 329 Diagrammatic construction of the *knotted* intersection of one pair of wefts with one pair of warps. The *wrapping weft* encircles the *interlacing weft* with which it is paired as well as the pair of warps intersected.

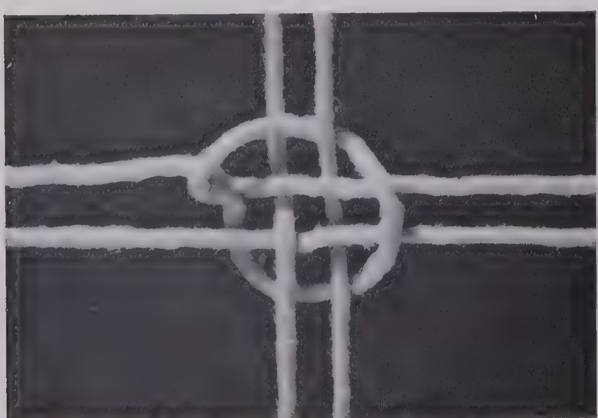

FIG. 330 Diagrammatic construction of the *knotted* intersection of a weft- with a warp-pair, in which the *wrapping weft* not only *wraps* and *knots* (as in fig. 329) but also *interlaces* the warp pair.

B. COMPOUND STRUCTURES

If, in a *weft-wrapped* fabric, the *wrapping weft* is an *extra weft, supplementary* to a ground weave, the structure of the fabric is *compound*, and the possibilities of structural variation are increased in many ways. Not only is the structure of the ground weave itself widely variable (although it is usually some form of *interlacing*) but it provides the fabric with its essential coherence so that the *wrapping weft* can be used with almost complete freedom, wrapping however and wherever desired. The major uses of *supplementary wrapping wefts* are similar to the uses of *supplementary wefts* generally. They can be used to add a complete surface or backing (either flat or pile) to a ground weave, giving the fabric additional depth and strength and increasing the possibilities of color variation and manipulation, and also to add areas of contrasted texture more in the nature of 'brocading.' When *wrapping wefts* are *supplementary* to a ground weave, there is, in addition to the variations possible in *simple weft-wrapping*: greater variation possible in the ratio of the forward to the backward movement of the *wrapping weft*; greater variation possible in the over-and-under sequences of the *wrapping*; greater possibility of contrasting areas of *wrapped* structure with areas of flat *interlacing*; and the possibility too of producing weft 'pile' by leaving loops of the *wrapping weft* free on the surface of the ground weave.

1. PLAIN EXTRA-WEFT WRAPPING

All progressive *wrapping* of warps by wefts can be analyzed in terms of the two essential weft movements — the movement by which warps are encircled, and the movement forward from one encirclement to another. In the 'Soumak' type (see p. 215) both are the simplest possible. Each encircling movement represents the simplest way of *wrapping* weft elements round warp (i.e. over and back under, or vice versa); each forward movement is a single uninterrupted movement of the weft over (or under) a given number of warp units before it turns back to wrap some of them. In this simple form (as noted on pp. 215 and 216) no additional weft or weft movement is essential to the coherence of the fabric structure as long as the *wrapping wefts* repeatedly turn back to encircle at least half the number of warps (or warp units) they crossed in moving forward, but the structure is nevertheless widely used in conjunc-

tion with a ground weft which *interlaces* the warps and produces a ground weave to which the *wrapping* is *supplementary* (see figs. 331 and 332). And though not requisite to the coherence of the fabric, this *interlacing* of a ground weft with the warps helps to keep the imbalance of the two faces of a *wrapping* structure from unbalancing the fabric as a whole; it also tends to give the *wrapping* structure more precision (compare figs. 331 and 333 with figs. 321 and 323, pp. 214 and 215).

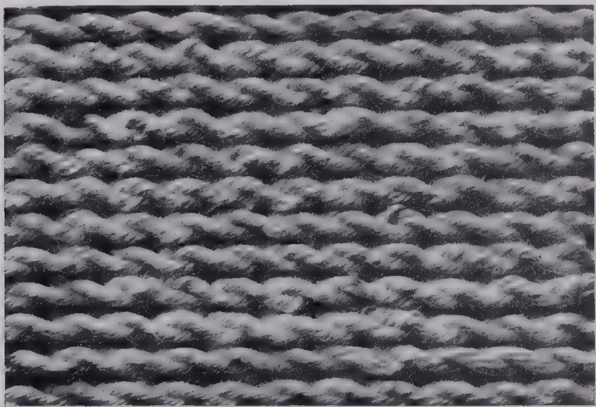

FIG. 331 *Plain extra-weft wrapping* on a *plain-weave* ground. The opposite face is *dissimilar*.

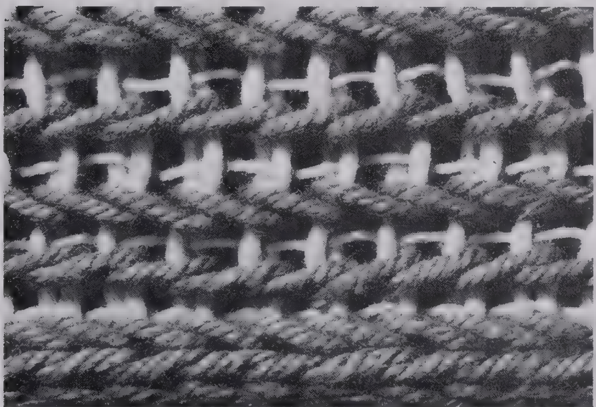

FIG. 332 Diagrammatic construction of *extra-weft wrapping* on a *plain-weave* ground. The *wrapping* is the 'Soumak' type and is 'countered.' The opposite face is *dissimilar*.

VARIATIONS

It is obvious that the addition of a ground weft in no way limits the use of the *plain weft-wrapping* structure. It can be 'countered' (fig. 333), 'turned' (fig. 335), or the over-and-under and forward-and-back sequences of the *wrapping* can be varied – just as in the *simple wrapping* structures illustrated on the preceding pages.

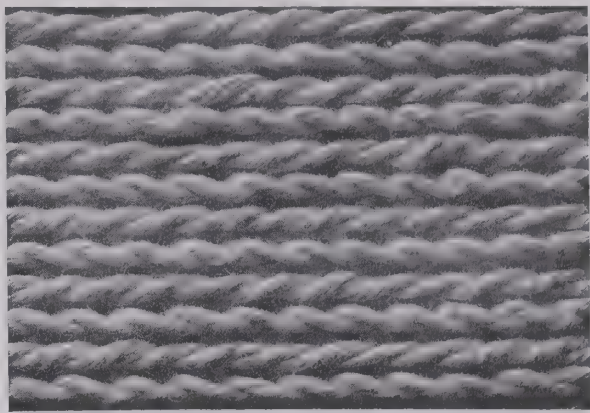

FIG. 333 *'Countered' weft-wrapping, supplementary* to a *plain-weave* ground. Opposite face of fig. 334.

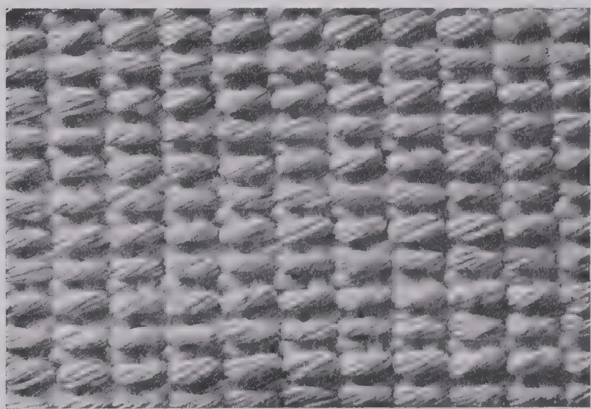

FIG. 334 Opposite face of fig. 333. Note that there is only slight evidence of the reversal, in successive passages, of the slant of the *wrapping weft*.

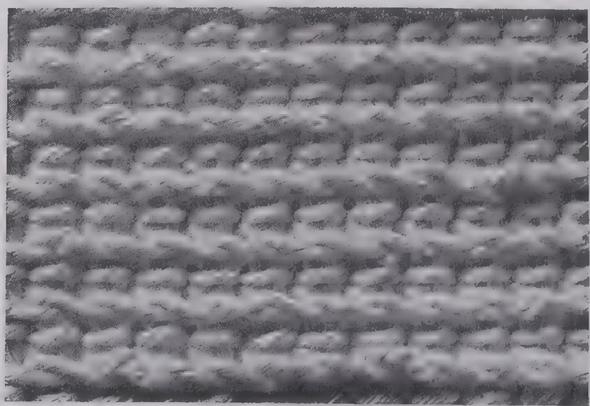

FIG. 335 *'Turned' weft-wrapping, supplementary* to a *plain-weave* ground. The opposite face of the fabric is *identical*.

But with the addition of a ground weft – making the *wrapping weft supplementary* – another kind of variation becomes possible, namely variation in the ratio of the forward to the backward movement. The basic 2:1 ratio that is essential if all warps are to

be encircled can be varied at will when there is a ground weave (see fig. 336, and note the opposite face, fig. 337; also figs. 338–340), as can the spaces between passages or between areas of *wrapping weft*.

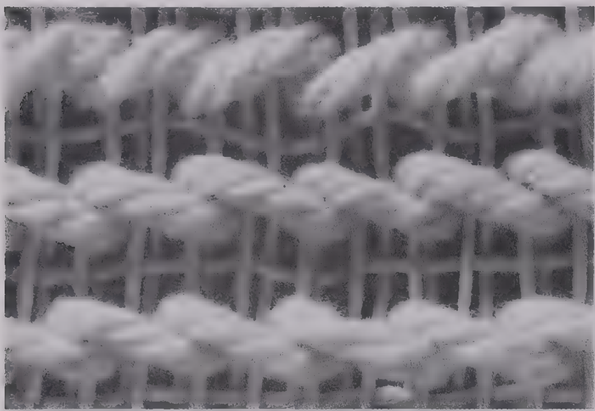

FIG. 336 Diagrammatic construction of *plain weft-wrapping* in 3:1 ratio (over-6-back-under-2) on a *plain-weave* ground. (The wrapping slant is reversed in the passage at the top of the illustration.)

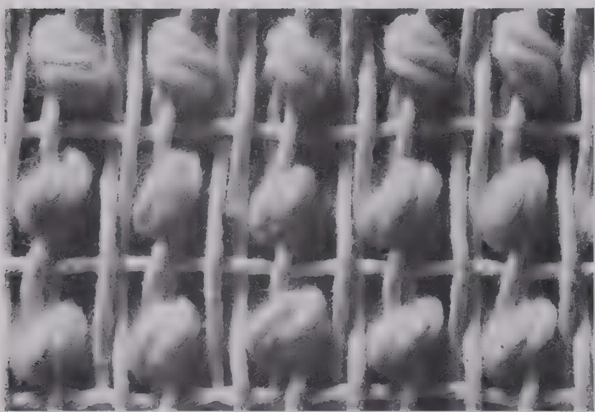

FIG. 337 Opposite face of fig. 336, showing how the use of a ground weave permits the omission of certain warps from the *wrapping* action.

Variations of both sequence and ratio can be combined and, obviously, the possibilities of different combinations are extensive. Figures 338 to 340, for example, show a variety of *supplementary-weft-wrapping* used by Pueblo Indians of the American Southwest (notably the Hopi) in their so-called 'brocaded sashes.' The movement ratio may differ from piece to piece, but in the wrapping sequence the forward movement is always both over and under warps, while the movement back is over. In this particular example, as in many, the wrapping sequence is forward under-2, over-8, under-2, then back over-2; the ratio is 10:2 – only two warp units in ten are encircled by the *wrapping weft*.

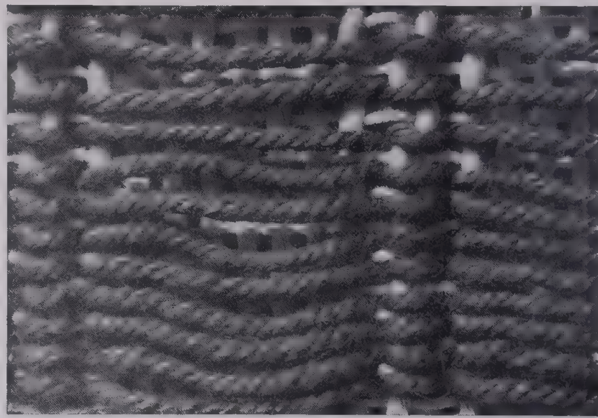

FIG. 338 Reconstruction of the structure of so-called 'Hopi brocading': compact, and more loosely worked.

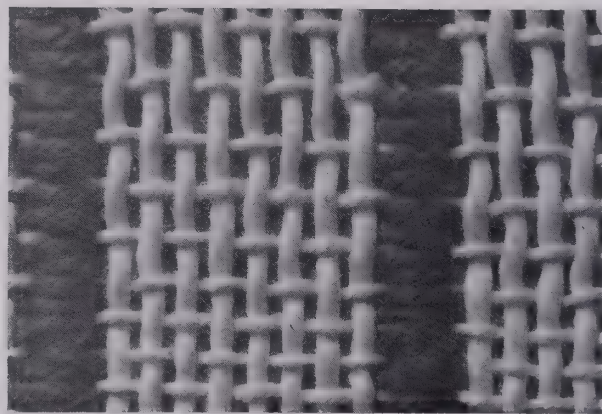

FIG. 339 Reverse of fig. 338.

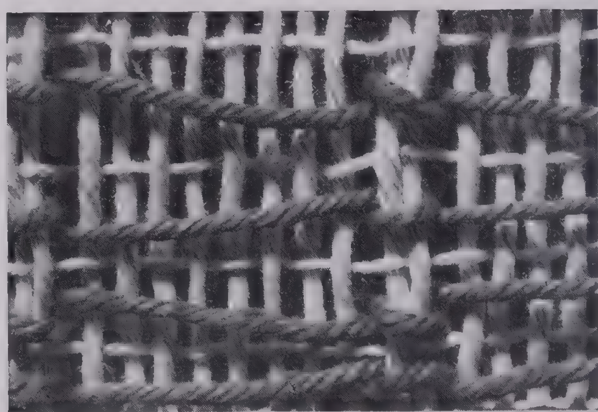

FIG. 340 Diagrammatic construction of the Hopi type of *supplementary-weft-wrapping* on a *plain-weave* ground shown in fig. 338. The wrapping sequence is under-2-over-8-under-2 and back over-2.

There may be further variation in *compound weft-wrapped* fabrics – in the interlacing order of the ground weft, and in the number of passages of *wrap-*

ping weft to each passage of ground weft, or vice versa. But although such variation is important for fabric description, and is often significant diagnostically, it does not affect the nature and variety of the *wrapping* structure.

2. EXTRA-WEFT PILE WRAPPING

In the simplest form of *woven-pile* (see p. 148), loops of an *interlaced supplementary weft* are drawn from the surface of the ground weave to form a *weft-loop pile*. When the *supplementary weft* is a *wrapping weft*, loops of it can be left free between the points at which it wraps round the ground-weave warps; and such loops are basic to the pile structures usually designated 'knotted-pile' (although actually *wrapped* rather than *knotted*, see NOTE, p. 214) and to the so-called 'pile-knots'– that is, the individual segments of the wrap-loop sequence – which compose it.

'Knotted-pile' loops, the looped segments of a wrap-loop sequence, can be formed on either side of a fabric or on both; they can be short or long, cut or uncut, spaced or contiguous; and the *pile wefts* can be continuous or discontinuous. A *ground weave* is essential both to give the fabric coherence and to secure the *supplementary wefts* between the free-standing loops; but the nature of it can vary (*plain weave* and *twill* are the most common) as can the proportion and relationship of *pile-* to *ground-weave*.

A. SO-CALLED 'PILE-' OR 'RUG-KNOTS'

Wrapping a *supplementary weft* round successive warps, instead of simply interlacing it with them, secures it and makes it possible to construct a heavy, durable fabric with a soft pile surface – a combination of textures well suited to rugs and so long and extensively used for them that certain of these *wrapping* structures have come to be described as 'rug-knots' and identified by the names of the rugs in which they were used, or of places where the rugs were made or sold. The two best known – and it is often stated categorically that 'rug-knots are of two kinds'– are the Ghiordes (or Turkish) and the Sehna (or Persian) 'knot.' The single-warp (Spanish, or European) 'knot,' although apparently earlier in use, was later in being described and named.

GHIORDES (OR TURKISH) 'KNOT' The Ghiordes, or Turkish, 'knot,' reputedly named for an Anatolian rug-weaving village, is less commonly known as the 'Smyrna knot' (see p. 226 for the term). It is usually symmetrical in structure (see fig. 342), as is the *weft-wrapping* on which it is based (fig. 341). Although related to *Soumak wrapping* (fig. 320, p. 214) in both sequence and ratio (over-2-back-under-1), as well as in the successive encircling of each warp unit, the Ghiordes *wrapping* sequence differs in having the forward-moving segments aligned in two transverse tiers rather than in a single series of slanted segments. The 'pile-loops' are formed by extending each lower-tier segment (compare fig. 342 with 341), and if these loops are cut, cut ends from each of two adjacent lower-tier loops will be found emerging together from between the two warps united by an upper-tier segment (i.e. the 'pile-ends' will emerge in pairs from each alternate space between warps).

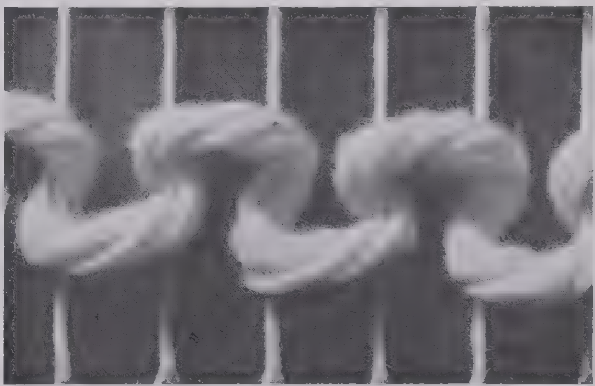

FIG. 341 The *weft-wrapping* sequence on which the Ghiordes (Smyrna, or Turkish) 'knot' is based – the forward-moving segments aligned in two transverse tiers.

FIG. 342 Diagrammatic construction of the *extra-weft pile-loop* structure known as the Ghiordes (Smyrna, or Turkish) 'knot'– showing extension of the lower segments in the *wrapping* sequence to form the 'pile-loops' (which may be cut or left uncut).

SEHNA (OR PERSIAN) 'KNOT' The 'rug-knot' known as Sehna (Sehneh, Sinna, Senna, etc.), or Persian, is named for a rug-weaving village in northwest Iran. Sometimes described as 'more of a running knot' than the Ghiordes, it is an asymmetrical structure in whose *wrapping* sequence only every other warp or warp unit is completely encircled (see fig. 343), but in which – when the pile-loops are cut – one 'pile-end' emerges from each space between warps. The 'pile-loops' can be formed in one of two ways. If the *wrapping element*, in encircling a warp, is brought back under it below where it crossed over (as in figs. 343 and 344), the wrapping slant will be down to the left and the loop will be formed where the *wrapping element*, having encircled one warp, moves forward to pass under the next. This is apparently the most common form of the structure; it produces pile that tends to lie to the left; and it is sometimes described as a 'right-hand Sehna knot,' sometimes as 'left-hand' (see p. 227).

FIG. 343 The *weft-wrapping* sequence on which the Sehna (or Persian) 'knot' often described as 'right-hand' is based.

FIG. 344 Diagrammatic construction of the *extra-weft pile-loop* structure sometimes called the 'right-hand' Sehna (or Persian) 'knot,' showing the point in the *wrapping* sequence at which the 'pile-loop' is formed.

FIG. 345 Diagrammatic construction showing (a) the *wrapping* sequence on which the Sehna (or Persian) 'knot' sometimes called 'left-hand' is based, and (b) the point in the sequence at which the 'pile-loop' is formed.

If, on the other hand, the *wrapping element* wraps back under the warp above where it crossed over it (see fig. 345, *a*), the slant will be up to the left; the pile-loop will be formed where the *wrapping element*, having passed under one warp, moves forward to encircle the next; and the pile will tend to lie to the right (fig. 345, *b*). This structure is sometimes (but not always) described as a 'left-hand Sehna knot.'

SINGLE-WARP (OR SPANISH) 'KNOT' This particular pile structure was apparently first identified as the 'pile-knot' peculiar to early Spanish rugs, and thus the 'Spanish knot' took its place alongside the familiar Ghiordes and Sehna 'knots' as a third type of 'rug-knot.' After the same pile structure was noted in certain medieval central-European fabrics it was sometimes described as the 'European knot'; but when also found in fragments of pile fabric from central Asia – thought to be earlier than any known examples of either the Ghiordes or Sehna 'knot'– it was sometimes described either as the 'most primitive form of pile-knotting' or 'not pile-knotting in the usual sense.'

Actually it is as much a 'knot' as any of the so-called 'rug-knots' and can hardly be judged either more or less complex than the more familiar Ghiordes and Sehna structures. As in the Sehna 'knot' the *pile-weft* usually completely encircles each alternate warp, but it crosses over instead of under the intervening warp (see fig. 346, *a*) and the loop is formed at that point (see fig. 347). If the loop is

cut, 'pile-ends' emerge singly from each space between warps. The *wrapping* can be either up to the left (as in figs. 346 and 347) or up to the right, although there may seem to be little in the pile fabric to indicate which.

It is interesting, however, and instructive, to note that the reverse of the up-to-the-left wrapping sequence of the *single-warp* 'knot' (fig. 346) exactly duplicates the wrapping sequence of the Sehna 'knot' shown in figure 345, *a*. The *single-warp* 'knot' is usually described (as all 'rug-knots' so often are) as if made with short lengths of *pile-weft*, although there seems to be no definitive evidence of the extent of this practice. The wrapping sequence (although not the ratio) is the same as that in the 'Hopi' type of *extra-weft wrapping* (fig. 340, p. 220) which, it should be noted, is wrapped down to the left (as in fig. 343) in one row, and up to the left (as in fig. 345, *a*) in the next.

FIG. 346 Face (a) and reverse (b) of the *wrapping* sequence on which the *single-warp* (or Spanish) 'knot' is based. (Note that the sequence in (b) is the same as that in fig. 345, a.)

FIG. 347 Diagrammatic construction of the *single-warp* (or Spanish) 'knot,' showing the point in the *wrapping* sequence at which the 'pile-loop' is formed.

B. SOME PRESUMABLY DEVELOPMENTAL FORMS

Although the most familiar examples of *extra-weft pile-wrapping* (or 'knotted-pile') are the so-called 'pile-' or 'rug-knots' of the rugs ('carpets') familiarly known as, and loosely designated, 'Oriental,' *weft-pile wrapping* is a type of construction that is widely used, and its forms are extremely varied. The three 'knots' just discussed do not necessarily represent the most complex, the last, or the highest technical attainment in the development of *extra-weft pile-wrapping*, but rather the particular forms that served as the vehicle for the development of the great rug traditions of the Near and Far East, North Africa and Spain, in our era. These classic 'rug-knots' have been studied and documented in considerable detail, but knowledge of the use of less wide-spread or perhaps less persistent forms, whether essentially simpler or more complex, is as yet incomplete; and the history of the origin(s) and early development of so-called 'knotted-pile' is yet to be written.

As in most fields of textile study, the investigation of 'knotted-pile' structures has been gradually pushed back, during the last century, from the already familiar and standardized forms, presumed to be the most advanced, toward whatever fragmentary evidence there may be of forerunners and possible origins of these forms. And as in other such investigations, the tendency has been to try to describe early variants, when found, in terms of techniques as they eventually crystallized.

Structurally intermediary between *extra-weft-loop pile* (pp. 148 f.) and *extra-weft pile-wrapping* (i.e. so-called 'knotted-pile') is a pile structure that has been variously designated 'Coptic knot' (Dimand, 1933, p. 159), 'open single-warp knot' (Lamm, 1937, p. 136), 'Sehna loop' (Pfister and Bellinger, 1945, p. 3), and so on (see p. 227). Actually it is not reducible to a *wrapped* construction as are other 'rug-knots,' nor is it structurally much more closely related to one of these than to another. It differs from all the *wrapped* constructions commonly used for pile somewhat as *single-element simple looping* (p. 31) differs from *interlooping* (p. 39); that is to say, it is constructed by manipulation not of the free end of the element but of a loop – in rope-making terms, a 'bight' – and is basically an 'endless thread' structure. There is no actual or complete encircling of any warp or warps, and whereas *wrapping* is made

FIG. 348 Diagrammatic construction of the most commonly reported variety of the 'slip-loop' type of pile structure. (In another variety, the loops are pulled forward under 2 warps instead of 1, and there are 3 warps instead of 2 between loops.)

tighter by pulling one end of the element, this loop would be 'slipped' or pulled out. For this reason, it would seem that the structure could be described as a 'slip' loop.

This 'slip loop' differs from the basic *weft-loop* structure because the *pile-weft*, instead of being secured by being laid in a shed of the *interlaced* ground weave and then drawn up in loops between certain points of interlacing, appears to have been laid across the warps and loops of it drawn under alternate ones (in its most commonly reported form, e.g. fig. 348) to lie free in loops on the surface. Each loop emerges, or is pulled free, from between two warps; and if the loop is cut, the two 'pile-ends' will emerge together. It is in this characteristic, as well as in crossing over at least two warp units between loops, that this 'slip loop' can be likened to the Ghiordes 'knot' (see fig. 342, p. 221) – but in contrast to the Ghiordes 'knot,' it is formed asymmetrically by drawing a weft forward under a warp (or warps) and allowing it to return under the same warp before continuing its forward movement over that warp and the next one. Beyond the fact that it is asymmetrical, any relationship to Sehna 'knotting' (in which the *pile-weft* never passes over or under more than one warp unit at a time) disappears on analysis of actual over-and-under sequences – as does any relationship to the *single-warp* 'knot' (fig. 347, p. 223).

NOTE: that this type of 'slip' looping is found in Swedish rug and pile-fabric weaving, as are a number of similar appearing structures in which the *pile-wefts* are further secured by a true *wrapping* round certain warp threads.

One cause of abstruse, and often contradictory, attributions of relationship between various 'knotted-pile' structures can be found in the practice of construing each so-called 'knot' as a separate unit (as it appears when the structure of a *cut-pile* rug is analyzed), which forces an arbitrary designation of the points at which a single 'knot' begins and ends. Differences in interpretation of just what constitutes a single 'knot' lead to such descriptive variety that not only may the 'knot' structure fail to be recognized for what it is but quite different attributions of its relationship to other 'knot' structures may be made.

Of course, some 'pile' structures (e.g. the *single-warp* 'knot') are more readily divided into specific units than others; and in a pile structure composed of bunches of unspun fiber, defined units are necessarily inherent. But the nature of pile structures and of their inter-relationships is seldom clarified by delimitation of the individual pile units. For example, in discussing the use of *supplementary wefts* for the simplest forms of 'woven-pile' (p. 148), we noted the laying of flocks or tufts of unspun fiber in the regular sheds of a weave structure, with one or both ends allowed to hang free in a shaggy, pile-like, texture. Such 'pile,' while obviously composed of specific units, is nevertheless closely related to *extra-weft-loop pile* (fig. 242, p. 148), a structure which is quite definitely not divisible into units. In another development – perhaps contingent on some fiber characteristic or the nature of the ground weave – we find flocks of fiber *laid in* a ground-weave shed and also *wrapped* round one or more warp elements (see fig. 349). Here again, each short length does actually con-

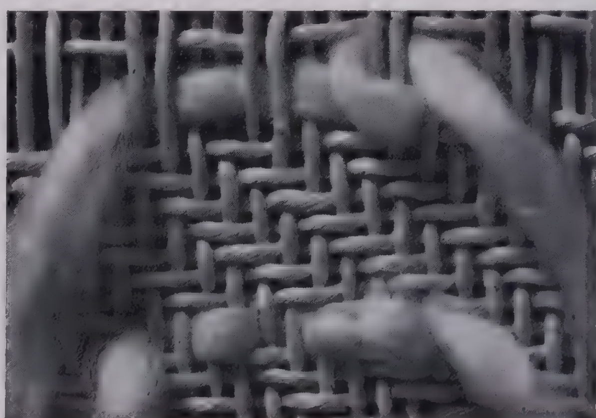

FIG. 349 Diagrammatic representation of the use of pile 'tufts' or 'flocks' not only *laid in* the sheds of a *twill weave* but also *wrapped* round certain warps.

stitute a separate unit of construction, but since the relationship of the ends of two adjacent units may well be closer and more significant in the pile structure than the association of the opposite ends of a single unit, the concept of 'units of construction' does little to clarify the concept of the pile structure.

It remains a debatable and as yet unanswerable question whether the so-called 'rug-knots' (which even in their developed rug-use are essentially *wrapping* techniques) represent a further development of 'laid-in tufts' to which the *wrapping* adds fixity, or whether they are direct developments from *wrapping* techniques — with lengthened loops to add an extra dimension — or perhaps a combined development. But pending the time when the record of early fabrics is far more complete, definitive, and communicable than at present, and when attributions of source are more exact both geographically and chronologically, informed awareness of possible lines of development may lead to a fuller understanding of the nature of fabrics characterized by 'wrapped,' 'wrapped pile,' and 'laid-in pile' structures.

Notes on the Use of Terms

Wrapping · Wrapped weave · Soumak wrapping

The term *Soumak wrapping* (*Soumak weave* or *Soumak stitch*) is not synonymous with *wrapping* (or *wrapped-weave, -work,* or *-stitch*). The name *Soumak* (*Sumak, Summak, Sumaq, Sumakh,* etc.) is usually explained as an abbreviation of — or as 'coming from'— Shemaka, one of a number of Caucasian towns, west of the Caspian Sea, where the flat-woven 'wrapped-weft' rugs and related fabrics called 'Soumak' are or have been made. The rugs are sometimes referred to as Shemaka rather than as Soumak, but *Soumak* is the more common term. And because the basic form of progressive *extra-weft wrapping* is the weaving technique consistently employed and most characteristic of the rugs, the term *Soumak* has come to be used to designate the technique (see pp. 54 f., 215, and 218) — even when the *wrapping wefts* are not *supplementary* as they are in Soumak rugs and Soumak weaving generally. The term *Soumak* when used technically to identify a structure is specific; it refers to a certain type of *weft-wrapping*, but not all *weft-wrapping* or even all *extra-weft wrapping* is of this type. In contrast, *wrapping, weft-wrapping,* and *wrapped weave* are all generic terms which usually connote the interworking relationship between weft and warp which is described as 'progressive wrapping of warp by weft elements' and in which, as we have seen, both the sequence and the ratio of the *wrapping* are subject to wide variation. In the *Soumak* type, the wrapping sequence is quite consistently forward over and back under; the span ratio is usually 2:1. In Soumak rugs, the *wrapping* is frequently 'countered' and is usually used in the 'tapestry' manner (i.e. with discontinuous wefts of different colors for different pattern areas) but these are to a large extent only different ways of orienting and using the same basic interworking structure, and are not necessarily implied in the use of the term *Soumak wrapping* or of *Soumak* as a technical designation of a *wrapping* structure.

The structural relationship of *plain* (or *Soumak*) *weft-wrapping* to 'stem stitch' in embroidery (see pp. 238 f.) was noted on page 215 but it should also be noted that reference to Soumak fabrics as examples of 'needlework' are not usually reliable and should not be read literally. There may be instances of the actual use of an eyed needle for insertion of the *wrapping weft*, but the procedure is uncommon even when the *Soumak wrapping* is used only for limited areas (sometimes described as 'Soumak inlay') and should not be postulated unless specific information is available.

NOTE: that Soumak rugs are sometimes called 'Kashmir,' although it seems that the use of this term (generally recognized as a misnomer and variously labelled 'erroneous,' 'fictitious title,' etc.) can probably be traced to the fact that the ends of the discontinuous wefts are frequently left hanging on the back of Soumak rugs, as they are on the back of many of the Kashmir 'shawls' that are *interlaced* in *twill tapestry.*

Knot · Knotted wrapping · Knotted-pile · Pile-knots · Rug-knots

In common concept, and in most dictionary definitions, the word *knot* refers to a tightened inter-

working of flexible elements which effects a fastening or 'tie' (see also p. 34) and which characteristically produces a kind of 'knob' or lump.

The idea of a tightened fastening or 'tie' is basic to the general concept of *knotting* as a way of interworking fabric elements and is the chief basis for distinguishing the *knotted* forms of *single-element looping, weft-twining*, and *weft-wrapping* (qq.v.) from the plain forms of the same structures, and *inter-knotting* from other forms of *oblique interworking* of the elements of a single set (see pp. 60 and 65). The distinction is evident in a differentiation that is often made between two general types of *single-element* 'netting.' The term *knotless netting* is widely used (although not definitively, see p. 46) to differentiate, in general terms, loosely meshed, sometimes net-like, *single-element* fabrics that are produced by means of *linking* or *looping* from fabrics designated *knotted netting*, in which the meshes or openings, being secured by *knots*, have fixed dimensions (i.e. *knotted looping*, q.v.).

Wrapping of weft round warp elements is one form of 'interworking,' and the *wrapping* can be tightened to effect a fastening of sorts. But if to the *wrapping* there is added the complexity of a *loop* in the wrapping element, through which the end of the wrapping element passes (e.g. fig. 328, p. 217), the fastening can be made more secure (i.e. the 'tie' may be said to be 'fixed'). Each *wrapping* of warp by weft will then conform to that complex of characteristics generally recognized as a *knot*; and the interworking may be described as *knotted wrapping* or, more specifically, as *knotted-weft wrapping* (see pp. 217 f.). 'Weft-twining' when secured at each turn of the wefts by a *knot* is usually referred to as 'tie-twining.'

NOTE: that the distinguishing quality of a *knot* is a relative fixity that is structural (i.e. not dependent on any qualities inherent in the element); and that the distinguishing structural characteristic of a *knot* is a loop in an element through which the same element passes.

What then of so-called 'knotted pile'? As we have seen (p. 221) the term *knotted-pile* has been widely used to designate certain forms of what are essentially *wrapped* structures, forms in which looped segments of the *wrapping weft* (which is necessarily a *supplementary* one) extend out from the surface of a ground weave to form the *pile*. But in such a structure, the *wrapping weft* does not pass through the loops it has formed, and it is the interlacing of a *ground weft* with the warp (i.e. the ground weave), rather than the interworking of the *wrapping weft*, that secures the loops. Nevertheless, any pile structure that is produced by a *wrapping element* has come to be differentiated from other pile structures by the designation 'knotted-pile,' and its units (conceptual units only, unless the pile is cut) identified as 'pile-knots' or, because widely used for rugs, as 'rug-knots.'

Although it is becoming more and more generally recognized that so-called 'knotted-pile' is, in fact, pile formed by *supplementary wrapping wefts* and is not really knotted at all, the use of the term *knotted-pile* persists; and segments of the wrap-loop sequence continue to be viewed as units of structure and referred to as 'knots.' But it is deceptive usage at best; the term *knotted-pile* is not always easy to translate, and its use can lead to many misconceptions. Furthermore, no statement of exactly what constitutes a 'true' rug- or pile-knot can be found; and as long as the characteristics requisite to a 'rug-knot' are not designated, statements to the effect that certain rug-pile structures are less truly 'knots' than others have little meaning – for example, "the single-warp knot . . . is scarcely a knot at all" (Tattersall, 1939, p. 17). Since the statement would apply to any of the so-called 'rug-knots' (and to many related structures) it is not valid as a point of differentiation.

NAMES OF SO-CALLED 'RUG-KNOTS':

Ghiordes · *Smyrna* · *Sehna* · *Spanish* · *Coptic*

Like all place or culture names appropriated for the designation of specific fabric structures, these names for some of the more widely used rug-pile structures are simply convenient tags whose structural connotations have been acquired by association. 'Ghiordes,' 'Smyrna,' and 'Sehna' are place-names, and each has come to be associated with a specific rug-structure. All three are the names of towns (two in 'Turkey,' the third in 'Persia') and have been used to identify certain rugs either made or purchased in them. (Products of all kinds which have been associated over a period of time with a certain place of manufacture, or trading center, and have been described as having 'come from' that place, often come

to be designated by the place-name.) When it eventually became important to identify and compare the structures of rugs, there was a natural tendency to name specific structures for the rugs in which they were found; and since the same rug-pile structure was found both in rugs which were known as 'Smyrna rugs' and in others known as 'Ghiordes,' we find both names used to refer to the same type of pile structure (which is also called 'Turkish,' since both towns were in 'Turkey in Asia'). Ghiordes was a 'rug-weaving village'; while Smyrna, throughout much of its long history, was important as a trading center and one of the chief ports of Asia Minor. Presumably 'Ghiordes rugs' were actually made in the village of Ghiordes, or at least nearby; but the name 'Smyrna' was apparently given not only to rugs made in the general vicinity but also to rugs from a wider area traded there.

The name 'Smyrna,' however, is sometimes also given to a 'stitch' used to effect 'embroidered' or 'accessory' pile (see p. 245), as well as to the pile fabrics so constructed – and this seems a logical transference as long as the word *stitch* is included in the term and it is recognized that *stitch* connotes sewing. But since 'Smyrna' is also used to name varieties of lace, embroidery, cotton fiber, cotton cloth, et cetera, the fabric connotations of the place-name are by now somewhat ambiguous – the more so since the expression 'Smyrna stitch' does not necessarily refer to the pile-producing stitch. In one instance, for example, "Smyrna Stitch" is equated with "Knot Stitch – Double" (Thomas, 1935, p. 185) which proves to be a kind of knotted couching "also known as . . . Coral Stitch" (*ibid.*, pp. 138–39), while the stitch called "Knotted Stitch – Single" is identified as "a Canvas Stitch which imitates the knots of a pile carpet . . ." (*ibid.*, pp. 140–41), and is diagrammed as a structure nearly identical with the Ghiordes, or Smyrna, rug-pile structure. On the whole, *Ghiordes* seems the less ambiguous term since its association is primarily with pile rugs, and since in the pile-rug context it quite consistently refers to the same symmetrical, over-2-under-1 wrap-loop sequence (fig. 342, p. 221). It is apparently chiefly in the Scandinavian literature that the term *Smyrna* is used instead of *Ghiordes* for this rug-pile structure.

NOTE: that 'Smyrna stitch' sometimes refers to the needle-lace stitch often described as 'knotted buttonhole stitch' (see figs. 24 and 25, p. 36), and that 'Smyrna' is also a trade name for the type of canvas on which 'embroidered pile' is usually worked, as well as being the term sometimes used to identify certain rugs with non-structural pile like those made with 'chenille' yarns (p. 149).

In contrast, the designation 'Sehna knot' is usually unequivocal, although the basis for the differentiation between 'left-hand' and 'right-hand' knots varies, as does their identification (compare, for example, Tattersall, 1939, Plate II, A and B, with the figure on p. 87 of Mumford, 1912). The validity of the expression 'Sehna loop,' however, is open to question since it rests on the assumption of a highly disputed relationship that would be difficult if not impossible to establish (v.i.).

The designation 'Spanish knot' for the pile structure first specifically associated with early Spanish rugs (and often described as used solely in them) but later identified in fabrics found both in central Europe and in central Asia (see pp. 222 f.) has tended to give way to a strictly structural term, *single-warp knot*. It should be noted, however, that although the expression 'single-warp knot' is usually employed as a term that designates one specific wrap-loop pile structure (fig. 347, p. 223), it is sometimes used more generically, and quite literally, simply to convey the fact that a certain pile structure is one in which "the end of the yarn is only laid round one warp" (Sylwan, 1941a, p. 49) – which is not necessarily the same thing. Furthermore, the view (sometimes specifically stated) that the *wrapping element* of the *single-warp* structure forms a cross behind the warp it wraps may be an interpretation of the 'knot' as usually diagrammed, rather than an accurate description of the relationship between the two segments of the *wrapping weft* which lie behind each warp; in practice, they are more likely to lie parallel than to cross (see fig. 346, *b*, p. 223).

The various terms given to the structure that Dimand (1933, p. 159) named the 'Coptic knot' were noted on page 223; the expression 'Sehna loop,' for example, was selected (Pfister and Bellinger, 1945, p. 3) to describe a pile structure (a "hybrid technique") presumably related in some way to the 'Sehna knot,' one in which Dimand (*loc. cit.*) had earlier noted a slight surface "resemblance" to the 'Ghiordes knot' and a "relationship" (undefined) to the 'Sehna knot,' while Lamm with his expression "open single-warp knot" (1937, p. 136) expressed a different view of its affinity. Since, as pointed out and illustrated

(pp. 223 f.), the structure is not in fact a *wrapping* structure, it should, obviously, be differentiated in nomenclature — as attempted in the expression 'Sehna loop' and suggested in objections raised to the term *Coptic knot* — from the structures usually referred to as 'pile-' or 'rug-knots' which are actually wrapped. On the other hand, objections to calling the structure 'Coptic' on the grounds that it has been found in pre-Coptic fabrics seem less valid, since it would be impossible to know when, in the investigation of early fabrics, the earliest existing example of any given fabric structure had been found, and since it would seem even more impractical to change the name of a structure each time an earlier example is identified than it is to add a new place-name term for a fabric structure each time it is found in a different place (a practice which partially accounts for the plethora of names for embroidery, that is, *accessory stitches*, q.v.).

If place- or culture-names are to be used at all as terms for fabric structures, it should be understood that their significance does not go beyond an indication of one recognized area of use — usually only one of many. Once established by usage, such terms serve as associative symbols, or tokens, in lieu of terms having strictly structural connotations.

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Burgh and Scoggin, 1948
Burling, 1953
Clark, H., 1922
Cosgrove, 1947
Coustillac, 1954
Crowfoot, 1943, 1956b
Crowfoot and Roth, 1923
Delpy, 1954
Dilley, 1909, 1931
Dimand, 1930, 1933
Douglas, 1933, 1938, 1939c
Douglass, 1946
Eaton, 1949
Ellis, 1961
Faraday, 1927, 1929
Ferrandis Torres, 1933
Fischel, 1951
Fung Pineda, 1960
Gallotti, 1939
Geijer, 1951
Handy, W. C., 1927
d'Harcourt, R., 1934, 1952, 1960
Haskins, 1956
Haury, 1934, 1945
Hawley, 1913
Heizer and Johnson, 1952
Hemneter, 1940
Holmes, 1884
Holt, 1937
Hough, 1914
Hunter, N. E., 1953
Innes, 1959
Jacoby, 1949
Joseph, 1928
Juvet-Michel, 1938
Kendrick, 1925
Kendrick and Tattersall, 1922
Kent, 1941, 1954, 1957
Kidder, A. V., 1926
Kissell, 1916a
Klein, 1961
Kühnel, 1953, 1957
Lamm, 1937, 1951
Leitch, 1928
Leix, 1941
Lewis, G. G., 1911
McGregor, 1931
Martin, and others, 1952
Mason, O. T., 1904
May, C. J. D., n.d.
May, F. L., 1941
Miner, 1936
Mumford, 1912
Nooteboom, 1948
O'Neale, 1936a, 1937, 1945, 1947, 1949a
O'Neale and Kroeber, 1930
Pfister and Bellinger, 1945
Pope, 1939
Riegl, 1895
Sautier, 1923
Saxe, 1928
Sayles, 1937
Sirelius, 1926, 1930
Stewart, 1953
Sylwan, 1934, 1941a
Tanner, 1950
Tattersall, 1939
Taullard, [1949]
Thacher, 1940
Van Cleef, 1923
VanStan, 1958a, 1960
Varron, 1939
Wallace, 1960
von Walterstorff, 1925
Wardle, 1936
Watson, J. F., 1866
Wilson, 1933
Wittlin, 1939

PART THREE

STRUCTURES ACCESSORY TO FABRICS

Fibers and filaments, the components both of *felted-fiber* structures and of the fabric *elements* that are, in turn, the components of all *interworked* fabric structures, are discussed briefly in PART ONE; and in PART TWO, at greater length, the ways in which both fibers and elements enter into fabric structures are categorized. One further phase of construction which must be considered in order to establish comprehensive means of describing and classifying the structures of complete fabrics is the addition of structures that are worked into or attached to fabrics – after, rather than during, the process of fabrication. Such structural additions can be designated *accessory structures,* and they fall into three main categories: *accessory stitches, accessory fabrics, accessory objects.*

Although fibers and filaments are the ultimate components of all fabric structures – either through the medium of *elements*, as in *interworked* fabric structures, or directly, as in 'massed-fiber' structures like *felt* – any given fabric structure may in turn, by the addition of *accessory structures,* become one of the components (usually the foundation) of a larger fabric complex.

Adding *accessory structures* to a fabric necessarily involves some means of attachment, and *stitches* commonly (though not invariably) serve as the means. When *stitches* in themselves constitute the *accessory structure*, attachment is an inherent attribute; but when *fabrics* or *objects* are used, with *stitches* serving as the means of attachment, there is opportunity for considerable variation in the relative importance of the *accessory fabrics*, or *objects*, and the *accessory stitches* which attach them. Such stitchery may serve only the structurally utilitarian purpose of attaching one thing to another; or it may be so elaborated that it is considered paramount, and any other *accessory structure* involved may be construed as a subordinate part of it (e.g. *appliqué,* when classified as 'embroidery').

PART THREE

Structures Accessory to Fabrics

I Accessory Stitches
(*see below*)

I ACCESSORY STITCHES

A. Elements

B. Uses

1. Functional
   a. Edge finishes
   b. Seams
   c. Repair and reinforcement
2. Decorative

C. Structures

1. Flat stitches
   a. Running stitches
      Double running stitch
      Twined double running stitch
   b. Overcasting
   c. Straight stitches
      Satin stitch
   d. Solid-line stitches
      Back stitch
      Stem stitch
   e. Crossed stitches
      Double-faced (or 'two-sided') cross-stitch
      'Long-armed' cross-stitch
2. Looped stitches
   Buttonhole stitch
   Feather stitch
   Chain stitch
   Cross-knit loop stitch
3. Knot stitches

Variant uses of stitch structures:
Detached stitches
Composite stitches
Pile stitches

NOTES ON THE USE OF TERMS

Names of 'styles' of embroidery:
Canvas work • *Tapestry work* • *Berlin work*
Crewel: *Embroidery* • *Yarn* • *Stitches* • *Stitch*
Couching • *Laid work* • *Self-couching*
Cut work • *Drawn work*

I ACCESSORY STITCHES

Accessory stitches may be either utilitarian (often described as 'plain sewing') or decorative (i.e. 'embroidery'), or both. The word *stitch* is apparently from the same root as the verb *to stick*, in the sense of 'to prick' or 'to puncture' ("OE *stice*, a pricking, a puncture," Partridge, 1959, p. 668). The association of a pointed implement, a needle or needle-like tool, with the idea of pricking or puncturing is inevitable; and the general concept of a 'stitch' as a unit of fabric structure involves the idea of passage of an element through an opening in the fabric, either one specifically created for that purpose (by needle or awl) or one inherent in the fabric structure (as, for example, in *looped* and so-called 'netted' fabrics).

> *Stitch*: one complete movement of an element through a fabric or portion of a fabric structure by means of a needle or with some equivalent implementation; also, the portion of the element disposed in or on the fabric by such a movement.

In the general fabric context, structural units of many different kinds and uses are designated 'stitches,' and different kinds of implements serve as the means of manipulating 'sewing' elements. There are the 'stitches' by means of which *single-element* fabrics are built up, that is, the 'stitches' which compose the structures called *linking*, for example, and *looping*. For these, if the element is fine, an eyed needle may be used (as in so-called 'needle lace'); if the element is bulky, a 'netting needle'; or if the element is stiff or can be stiffened, the end of the element itself may serve instead of a tool. In any case, something fulfills the function of a needle and each complete movement of it is usually called a 'stitch.' For the *linking* or *looping stitches* of *two-single-element* constructions (taken over a foundation element), an eyed needle is used in lace-making, whereas in basketry an awl is employed to puncture the foundation element or to expand the space between elements to permit the 'sewing' element to pass through and form the 'stitch.' In *interlooping*, on the other hand, since the structure is not built up by drawing the entire unused length of the element through a previous loop in order to form a new one, the implements used are not thread-carrying implements (and are not eyed). For example, in *knitting*, they are usually slender pointed implements on which loops can be carried until interworked with subsequent loops; but these implements are usually called 'needles,' and the loops referred to as 'stitches.'

All these, however, are examples of what might be called the 'constructional' use of stitches, that is, they are stitches used to construct a fabric; whereas *accessory stitches*, which we are now taking under consideration, are to a large extent 'stitches' in the more conventional sense — that is, stitches taken through a fabric with a threaded needle by the process known as 'sewing.' The 'sewing' element (thread, yarn, or whatever it may be) forms the *stitches* which are the structural units of stitchery. They are used for various purposes: to fasten something to a fabric; to fasten fabrics together; to finish, to repair, or to embellish fabrics.

A. Elements

'Sewing' elements are the structural components of all *accessory stitches* whether functional or decorative. They have their own *material content* and *structural make-up* (see pp. 4 ff.) and are described and classified in the same way as the *elements* that are the constituent parts of *interworked* fabric structures.

B. Uses

Although *accessory stitches* are used for both functional and decorative purposes, many of the decorative uses undoubtedly developed from such practical necessities as finishing or reinforcing raw edges of fabrics, or uniting two fabric edges by means of a seam. Even the decorative possibilities of repair (of darning, mending, and reinforcing stitches) have on occasion been so highly developed that the original need for the work is lost sight of. Most of the basic stitch structures here described (pp. 234 ff.) have functional uses; all of them have decorative uses.

1. FUNCTIONAL

There are countless practical or functional applications of stitchery whose variety is such that it is more customary to list and describe them individually than to attempt to group and classify them. However, aside from the attachment of *accessory fabrics* or *objects* and such fabric shaping and manipulation as 'gathering,' 'pleating,' 'tucking,' and the like, most of the major practical functions of *accessory stitches* can be grouped under three general headings: *edge finishes, seams,* and *repair and reinforcement.*

A. EDGE FINISHES

Stitches are used to prevent raw edges from fraying, to strengthen edges, and to guard against undue wear. They may be used to secure a hem or binding, or, more directly, to over-sew an edge. Simple *overcasting, whipping*, and various *crossed, looped*, and *knotted-loop* stitches (qq.v.) are the most useful for this purpose.

B. SEAMS

A *seam* is defined as the 'junction made by sewing together the edges of two pieces of cloth,' and the word *seaming* describes the stitches employed to fasten two or more fabrics together (to increase the available fabric area), or to join two edges of a single fabric (to form garments or containers, or otherwise to shape a fabric for some specific purpose). *Flat* line-forming stitches taken through the two fabric edges simultaneously are commonly used for *seams* (e.g. *running, double running, back stitch*, qq.v.), but in addition *overcasting stitches* can be used for a seam which will open out flat, and various *looped stitches* (pp. 241 ff.) can be worked alternately into one fabric edge and then the other to form a flat interworked junction which serves the double function of finishing and joining edges (an 'insertion' type of stitchery often decoratively elaborated).

C. REPAIR AND REINFORCEMENT

An important function of stitchery is fabric *repair* — to extend the useful life of a fabric by counteracting the effects of wear and destructive accidents. Stitches are used to darn holes, mend breaks and tears, and reinforce weakened areas. Flat 'line' stitches like *running, double running*, and *back stitch* are especially practical for *reinforcing*, which often takes the form of 'running' extra threads into the fabric to duplicate the interlacing of weakened or broken elements; but the *accessory-stitch* equivalent of *weft-twining*, 'twined double running stitch' (p. 235), is also sometimes used to add lines of reinforcement (often decorative) to a woven fabric, as is 'stem' or 'back stitch' (pp. 238 f.), the sewing equivalent of *weft-wrapping*; and obviously 'edge finish' techniques (v.s.) are useful for mending worn or torn edges.

NOTE: that the term *darning stitch*, although sometimes either equated with *running stitch* or associated particularly with certain decorative 'surface' or 'detached' uses of it (p. 244), is also often defined more generically as 'a stitch used in darning.' Since the word *darning* usually implies the filling of a hole in a fabric, the term *darning stitch* serves to denote more specifically the use of two interlacing series of *running stitches* to fill an open space.

2. DECORATIVE

Any example of the use of *accessory stitches* to decorate or embellish a fabric (i.e. any 'ornamental stitchery'), whether or not the stitches also serve practical purposes, can be classified as *embroidery*. The word *embroidery* is variously credited with coming from the same root as 'braid,' from the same root as 'border,' and with being related to a root word meaning 'spike'; but regardless of source, it refers almost without exception or limitation to the embellishment of fabrics by means of needle-worked stitches.

C. Structures

Stitchery is, in a sense, the working of a *single-element* construction into a pre-existing fabric by means of a threaded needle. One *stitch* is distinguished from another, structurally, by the particular relationship of one portion of the element to another and to the fabric into which it is worked. *Accessory stitches* are the least restricted of fabric constructions. Being free of any need for either directional conformity (as is necessary in the *interworking* of *warp* and *weft elements*) or structural coherence (as required in *single-element* fabric structures), they can be used, varied, elaborated, combined, invented, and re-invented, almost without limit. But although apparently endlessly variable in both form and nomenclature, individual *stitches* can be analyzed to determine their basic characteristics –'composite' stitches broken down into their component stitches, and simple stitches into their component parts – and when analyzed, many of the stitch structures commonly distinguished from others and individually named prove to be not so much specific stitches as specific combinations or specific applications of them (see pp. 244 f.).

Simple stitch structures fall into three general categories: *flat stitches*, *looped stitches*, and *knot stitches*. In the following pages a few that seem fundamental will be described and illustrated, and reference will be made to some of their interrelationships and to analogous fabric structures, but there will be no attempt to chart the range and variety of even the most common stitches or to deal, even superficially, with the aggregate of accumulated terms.

1. FLAT STITCHES

Flat stitches are surely the most elementary of the structures added to fabrics by means of needle and thread. They can be described as 'those formed by working the needle alternately in and out of a fabric and thus laying the sewing element flat and straight on first one face of it and then the other.' The 'stitches' may or may not be aligned with the elements that compose the foundation fabric, and the relationship of the part of the stitch that lies on one face to that on the other may vary in direction as well as length; but in *flat stitches* there is no interworking of the element, on either face, although one stitch may overlap or even cross another.

NOTE: that the term *flat stitch* is sometimes used, particularly in older books on 'embroidery,' not as a generic term for all *flat stitches* but to specify one stitch or another (e.g. *running stitch*, or *satin stitch*) if and when used to produce a flat smooth surface. The fact that the same stitch may be called by different names when used differently, and different stitches by the same name when used for the same purpose, is one of the reasons that stitchery has acquired its confusing multiplicity of terms.

A. RUNNING STITCHES

The term *running stitch* describes, and quite consistently refers to, not only the simplest of *flat stitches* but the simplest possible stitchery. In *running stitch* the thread is carried forward in and out of the fabric to form a line of stitches on each face. The stitches may be the same length on both faces (see fig. 350, *a*), or longer on one than on the other (fig. 350, *b*); but the general direction of the stitch movement is the same on both.

NOTE: that although *darning stitch* is occasionally differentiated from *running stitch* on the basis of the relative length of the stitches on the two faces, there is little agreement about which of the two stitches is characterized by inequality (fig. 350, *b*) and which by equality

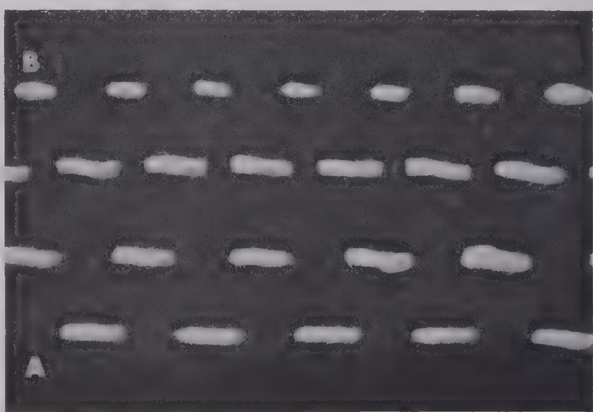

FIG. 350 Face and reverse of two basic forms of *running stitch*. In a) the stitches are the same length on both faces; in b) they are longer on one face than on the other.

(fig. 350, *a*). Agreement is also lacking on how and whether to differentiate so-called 'basting stitch' which is sometimes said to be characterized by some ordered variety in the length of successive *running stitches* (e.g. two short and one long).

Without varying its essential nature, *running stitch* can be applied in a great variety of ways. It may be worked in any direction or series of directions; in straight or curved lines; in close or open parallel rows with any desired alignment of stitches. Worked in close parallel rows, for example, with long stitches on one face (e.g. fig. 352) it will produce on that face a flat, smooth surface suggestive of *satin stitch* (q.v.), and so used it is often described as 'pattern-' or 'surface-darning.' Invariably, however, in *running stitch* the spaces between the stitches on one face will be spanned by those on the opposite face.

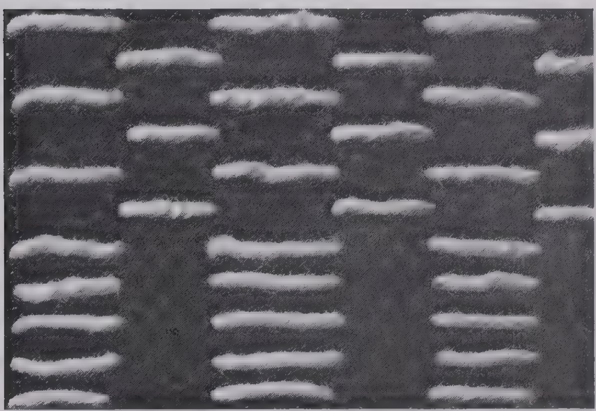

FIG. 351 Parallel rows of *running stitches* in both alternate (at the top) and vertical alignment.

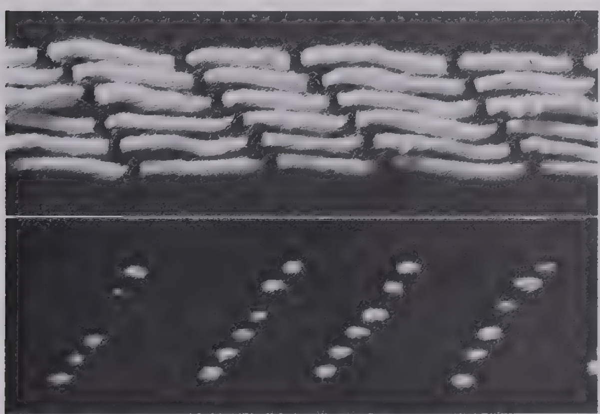

FIG. 352 Face (above) and reverse (below) of close-worked parallel rows of *running stitches* in diagonal alignment – sometimes described as 'pattern-' or 'surface-darning,' sometimes specifically named 'false twill,' and so on.

DOUBLE RUNNING STITCH If a second line of *running stitches* is worked back over the route of the first, filling in on both faces the spaces left between the stitches of the first line, identical solid lines of contiguous stitches (see fig. 353, *a*) will be produced on both faces. This is usually described as 'double running stitch,' less often as 'double darning stitch,' 'line stitch,' 'two-sided line stitch,' 'two-sided stroke stitch,' et cetera. When it is referred to as 'reversible or two-sided back stitch,' it must be assumed that the expression 'back stitch' refers to the 'return journey' rather than to the *two-faced* stitch usually identified as 'back stitch' (q.v.).

NOTE: that because of numerous representations of examples of the use of this stitch in Holbein's paintings, the stitch is often called 'Holbein stitch'; while because of the extent of its use in Roumanian embroidery, it is also known as 'Roumanian stitch,' analogously as 'Italian stitch,' and so on.

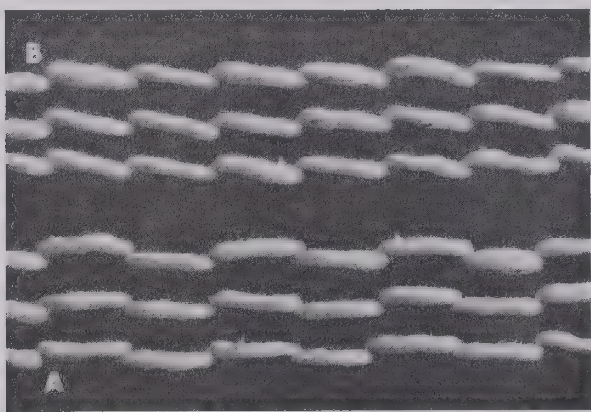

FIG. 353 *Double running stitch*: a) plain, sometimes called 'double darning stitch'; b) *twined double running stitch*. In both, the two faces are *identical*.

TWINED DOUBLE RUNNING STITCH If the returning thread always goes into the material just below the thread of the first passage and comes out just above it (or vice versa), the two threads will actually turn about each other, and the stitch (if this characteristic is noted) will usually be designated *twined double running stitch* (fig. 353, *b*). However, this is often described not as a different stitch but as the proper way to execute *double running stitch* (to avoid the 'stepped effect' apparent in fig. 353, *a*). Fineness of both thread and foundation material tends to diminish the visible differences between the two stitches but does not affect the *identity* of both structures (and the slant of the 'twining') on the two faces.

B. OVERCASTING

The term *overcasting* describes one of the major uses of the *overcasting* (or *whipping*) *stitch*, a simple practical stitch which is basically a kind of *running stitch* taken over the edge of a fabric (see figs. 354, *a*, and 355, *a*). It can, in fact, be construed as an adaptation of *running stitch* to the 'finishing' of a raw edge. That is, instead of moving straight forward in and out of the material, the needle repeatedly emerges from it on the working face and enters it from the reverse so that each stitch passes over the edge leaving part of the thread on one side, part on the other. Both the structure of the stitch and its slant in relation to the edge of the fabric are *identical* on the two faces.

NOTE: that this is basically the same 'stitch' movement as that used in *single-element* fabric structures to form *simple linking* (p. 30), and used in *two-single-element* constructions to form the *linking stitches* (pp. 52 f.) taken over a foundation element. (Some terms for the stitch are discussed on p. 45.)

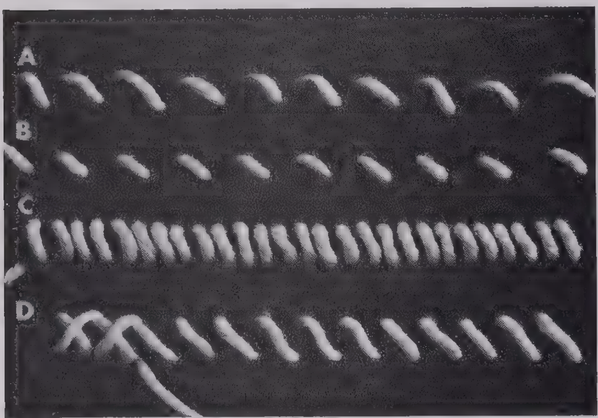

FIG. 354 Showing the relationship of a) *overcasting* (or *whipping*) *stitches* taken over the edge of a fabric, to simple 'stroke' stitches worked into the body of it: b) identical in proportion and placing with *a*; c) with less slant and closer set, approximating 'satin,' 'Gobelin,' and other stitches; d) with an adjustment of spacing and slant suited to use as the 'half stitch' (or 'first journey') in the construction of 'cross-stitch.' (Two crosses of the 'return journey' have been completed.)

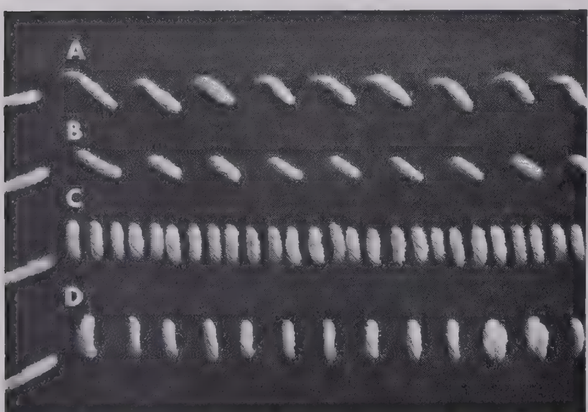

FIG. 355 Opposite face of fig. 354: a) and b) *identical* with fig. 354, *a* and *b*; c) and d) show the vertical stitch, which may be used instead of the slanting stitch as the 'face' of the work.

C. STRAIGHT STITCHES

By taking the entire stitch into, instead of over the edge of, the fabric, a structure (figs. 354, *b*, and 355, *b*) nearly identical with the *overcasting stitch* at *a* will be produced in the body of the fabric, but the stitch will no longer necessarily be construed as an 'overcasting' or 'whipping' stitch. It may be called a 'straight stitch,' a 'stroke stitch,' a 'tent stitch,' or a 'half stitch'; or it may be still more variously named – depending on the length of the stitch in relation to its slant and its spacing, on whether the slant is the same on both faces, and on innumerable other small and large variations of proportion, direction, and arrangement. But whether worked over the edge or into the body of the fabric, the same basic stitch is often worked back over the same route either filling in spaces (and forming a zigzag line) or crossing the original slanting stitches (see fig. 364, p. 240).

The direction in which stitches are worked affects the form of the stitch on the reverse. For example, short straight parallel stitches of equal length, slant,

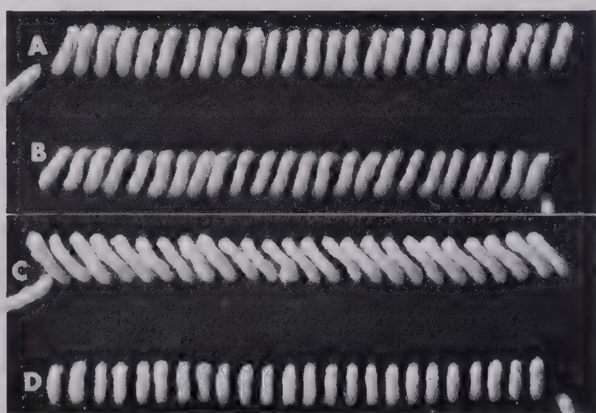

FIG. 356 Face and reverse of two horizontal rows of slightly slanted 'stroke' stitches: a) worked from right to left; b) from left to right. At *c* the increased slant of the stitch on the reverse of *a* is shown; at *d*, the vertical stitch on the reverse of *b*.

and spacing (e.g. fig. 356), if worked from right to left (*a*), will show on the reverse (*c*) stitches with a somewhat longer slant than on the face; whereas if worked from left to right (*b*), the slant of the stitches on the reverse will always be less than on the face and the stitches may be vertical (*d*). The name given the stitch may be affected not only by the relation of face to reverse (and by which face is used as the 'right side') but also by variations in the spacing and arrangement of individual stitches (e.g. 'tent stitch,' 'tapestry stitch,' 'Gobelin stitch,' 'upright Gobelin,' 'cushion stitch,' 'Irish stitch,' 'Florentine stitch,' and so on).

NOTE: that according to some definitions 'straight stitches' are always precisely vertical or horizontal, and may or may not be equated with 'stroke' stitches; while in other usage only 'upright' stitches are described as 'straight stitches' and no mention is made of horizontal or oblique equivalents. Frequently too it is not the individual stitches that are named, but their disposition or arrangement.

SATIN STITCH So-called *satin stitch* is a simple, straight, flat stitch largely distinguished from others in the same general category by the relative length of the stitches in the somewhat specialized use to which they are customarily put. It probably owes its name to its usefulness in producing a flat smooth surface which suggests (or imitates) the characteristic surface of *satin weave*, although the name is sometimes attributed to the wide-spread use of *satin* as the foundation fabric for the stitch. But the distinguishing structural characteristic of the stitch is the virtual *identity* of the two faces. As commonly used, the term *satin stitch* refers not so much to a distinctive stitch as to a distinctive way of disposing simple straight flat stitches; that is, it refers to a way of *double-facing* certain areas of fabric by laying a series of fairly long straight stitches parallel and close together on both faces, each stitch returning on the reverse of the fabric to a point contiguous to its starting point, so that the area is covered on both faces by *identical* stitches (see fig. 357, *a* and *b*). Usually the qualitative satin-like characteristic and the structural equivalence of faces go together; but when, for example, the end of a line of *double running stitches* is described as being 'a single satin stitch,' it is only the *double-faced* structure that the term denotes; and when, on the other hand, the flat smooth surface characteristic of *satin* and *satin stitch* is produced on one face of the fabric but not on the other (fig. 357, *c* and *d*), the stitch is usually, and quite properly, designated *false satin stitch*, or, more ambiguously, 'surface satin stitch.'

Satin stitches can be arranged in many different ways — to shape areas, to fill them, and to vary the pattern and texture within an area by changing the direction in which the stitches are laid on the surface (e.g. fig. 358 which shows *satin stitches* arranged in 'herringbone' pattern) — but the pattern and texture as well as the structure will always be *identical* on the two faces. Analysis of the connotations of various 'stitch names' makes it clear that there are many that refer to certain uses of *satin stitch* and that designate not stitch structures but certain specifically ordered arrangements and lengths of *satin stitches* (e.g. 'long-and-short stitch,' 'plumage stitch,' 'shading stitch,' 'brick stitch,' 'Japanese stitch,' and so on).

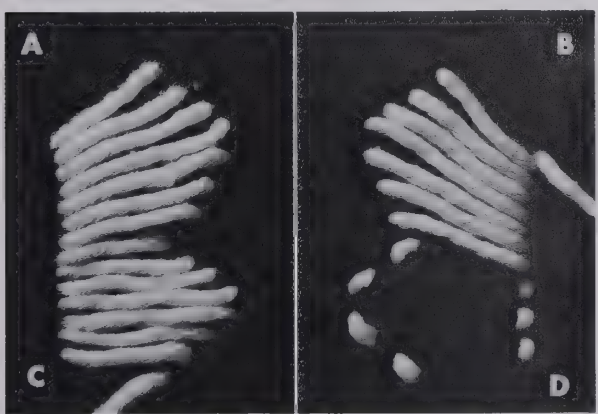

FIG. 357 Face (left) and reverse (right) of *satin stitch* (a and b) and *false* (or 'surface') *satin stitch* (c and d).

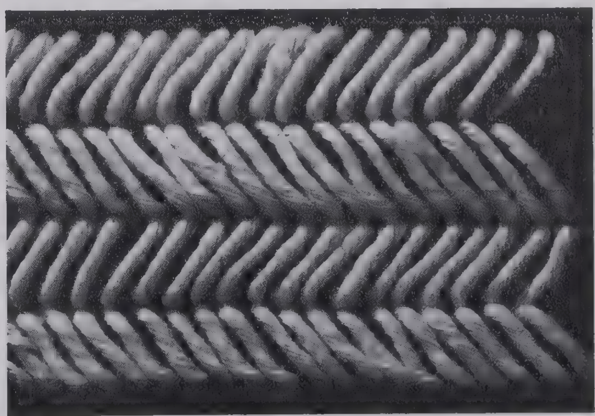

FIG. 358 Four rows of slanting *satin stitches*, with the slant reversed in each successive row to form a 'herringbone' pattern. The opposite face is *identical*.

NOTE: that among stitches that look much alike on one face but are actually quite differently constructed (with different names not necessarily indicative of differences in structure) are the two in figure 359 which show patterning that suggests 'herringbone.' The stitch at *a* is often designated 'open fishbone stitch' (although it is only one of many quite variant stitches described as 'fishbone') while the term *fishbone stitch* is sometimes illustrated by the stitch at *b*, which may on the other hand be designated 'leaf stitch' or (apparently depending on the slant of the stitches) 'flat stitch.' These two and many other similar appearing and sometimes similarly constructed stitches are all *flat stitches*, particular examples of which clearly cannot be accurately designated simply by the use of a 'stitch name.'

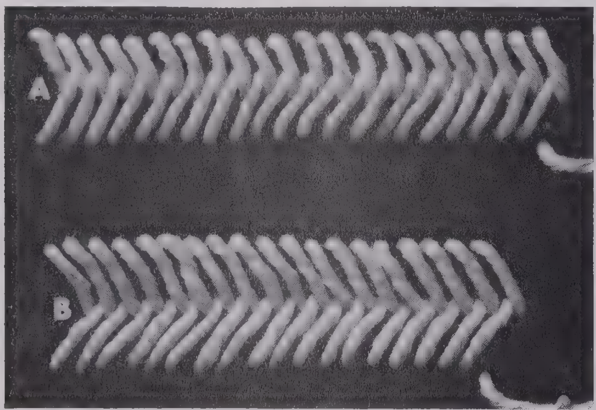

FIG. 359 Two arrangements of straight *flat stitches* in double series slanted alternately up to the right and up to the left to produce a 'herringbone' or 'fishbone' pattern: a) often designated 'open fishbone stitch'; b) may be designated 'fishbone,' 'leaf,' 'flat stitch' and so on. (Obverse of fig. 360.)

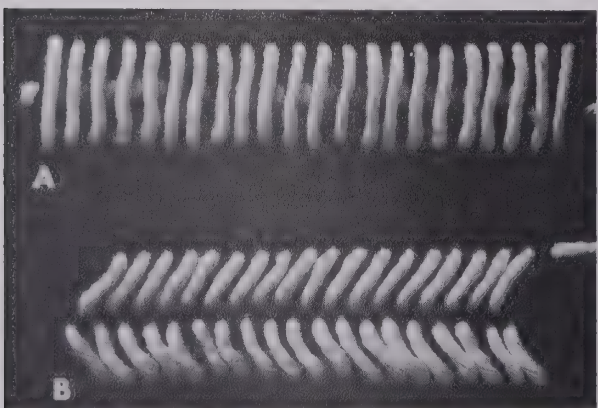

FIG. 360 Reverse of fig. 359: a) there are two vertical stitches, one short, one long, for each pair of opposite slanting stitches on the obverse; b) each two-part, two-slant 'stitch' produces a single chevron on both faces (and could be construed as a pair of *satin stitches* on opposite diagonals).

D. SOLID-LINE STITCHES

In *running stitch*, which is the simplest possible 'line' stitch, the thread moves straight forward producing a broken (or intermittent) line; to make the line *solid*, the spaces must be filled by a second series of stitches. To produce a *solid line* in one 'journey,' a stitch movement must be alternately forward and back along the line of progress; and this will cause the stitches to overlap on one face at least, since, as in *weft-wrapping* (see p. 214), the forward movement must be greater than the backward. Thus the two faces of such a stitch structure will always be *dissimilar*. If simple forward-moving stitches are taken on the face of the work (fig. 361, *a* and *b*), the stitch is usually designated 'stem' or 'outline,' sometimes 'crewel,' stitch; if the overlapping is on the underside of the work (particularly if the short stitches on the face are contiguous) the stitch will usually be designated 'back' stitch (fig. 361, *c*).

BACK STITCH The term *back stitch* commonly refers to the basic means of making a single unbroken line of sewing in one 'journey.' The stitch is widely used for practical as well as decorative purposes. In either use, the length of the 'back' stitch equals the extent of the overlap on the opposite face; and in what may be considered the basic form of the stitch, the 'back' stitches are half the length of the forward-moving overlapping stitches and lie end to end along the line of movement. A quite different appearance is produced by a comparable stitch movement if the stitches lie at an angle to the line

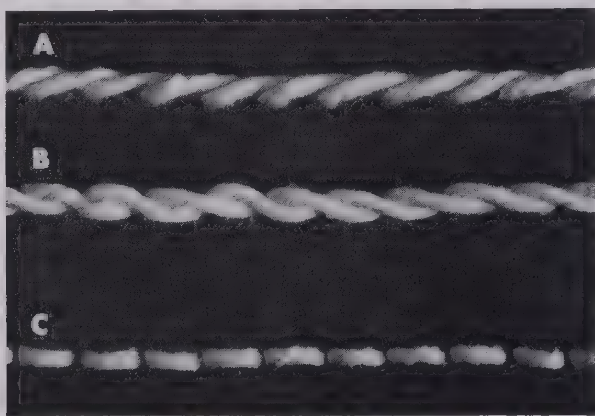

FIG. 361 The two faces of the overlapping stitches used to form a *solid line* of sewing: a) slanting up to the right (sometimes called 'outline stitch'); b) *stem stitch*, slanting down to the right; c) the reverse of *a* and *b*, or *back stitch*.

of progress (e.g. fig. 356, *a*, p. 236, sometimes described as 'slanting back stitch') but the term *back stitch* is usually specifically associated with linear stitching, the 'back' stitches forming the 'line'; and although the overlapping stitches on the opposite face are forced by the overlap to lie at a slight angle, they, too, serve to delineate a line and thus merit several of the terms common to them, viz. *stem stitch, stalk stitch*, and *outline stitch*.

STEM STITCH If the forward-moving overlapping segments are on the face of the work, the stitch – no matter what the ratio of forward to backward movement – is usually known as 'stem' or 'outline' stitch. The difference in the form and effect of the stitch which results when the thread is carried to the left of (or above) the needle and that when it is carried to the right (or below) should be noted, since the first (fig. 361, *b*, and fig. 362, *a*) is often designated 'stem stitch' in contradistinction to the second (fig. 361, *a*) which is called 'outline stitch.' On the other hand, these two forms are frequently described as two different ways of working 'stem stitch.' The visible distinction is to be found in the slant of the stitch, which, if viewed vertically (as a cord would be in determining the direction of twist), will in the first instance be in the Z direction, and in the second, S.

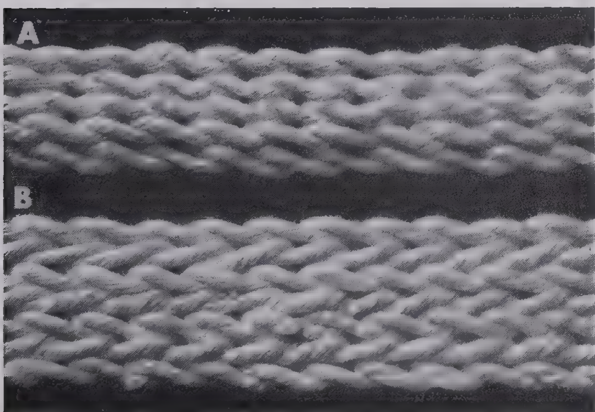

FIG. 362 Contiguous rows of overlapping stitches, as used for 'filling': a) unvaried down-to-the-right slant; b) opposite slant in successive rows (i.e. 'countered').

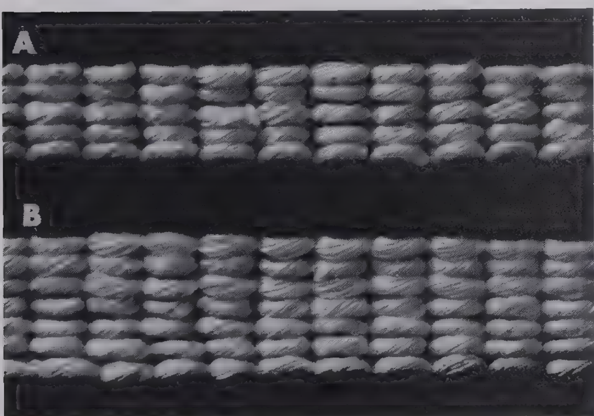

FIG. 363 Reverse of fig. 362.

It has been noted (pp. 54, 55, and 214 ff.) that the movement of *wrapping* one element about others that extend in the opposite direction is comparable to that of 'stem stitch' in sewing; and that the fabric structure, *weft-wrapping*, is often described in terms of its *accessory* counterpart, 'stem stitch.' In a line of *stem-stitch* sewing, many of the characteristics exhibited by a *wrapping element* will be found, notably the slant of the overlapping stitches in relation to the line of work, and the relatively short straight stitches on the opposite face. Although named for its linear use, *stem stitch* is often used as a 'filling' stitch for areas of color or texture (fig. 362) and can be varied much as *weft-wrapping* is – by alternating the slant of the stitches, for example, in successive rows (see fig. 362, *b*).

E. CROSSED STITCHES

The terms *crossed stitch* and *cross-stitch* both describe a relationship between two *flat stitches*; and the second can be used to further specify that the two flat stitches are identical. That is, all *crossed stitches* are two-part constructions, but what is specifically designated *cross-stitch* is a unit stitch composed of two identical short 'straight' or 'stroke' stitches crossing the same small area at opposite angles. (Each single stitch may be crossed before the next is worked, or a whole row of parallel slanting stitches – sometimes called 'half stitches' or 'half-cross stitches'– may be worked first, and the crossing stitches worked in a second 'journey.') *Crossed stitches* in many forms are used both in 'plain sewing' and in embroidery; but the term *cross-stitch* usually applies to one quite specific embroidery stitch. Although both the way of working the stitch and the material on which it is worked are frequently specified both in definitions and in descriptions of 'cross-stitch,' in most usage applicability of the term *cross-stitch* (unlike many terms for stitches) seems to be independent of method, material, or the ar-

rangement of stitch units. However, there is considerable variation in the rigidity with which the term is delimited; and it may even be stipulated that the crossing segments of the stitch must be of equal length, must cross at right angles, and must form the diagonals of a perfect square – also that the term must be qualified if the *crossed stitches* deviate from this formula (e.g. 'oblong cross stitch').

NOTE: that these stipulations are undoubtedly related to the use of canvas or some 'square-count' material open enough for the *crossed stitches* to be worked on 'counted threads,' and they help to establish the basic nature of *cross-stitch* and perhaps explain its frequent identification with so-called 'canvas work' (see p. 246), to the point of being sometimes referred to as 'canvas stitch.' However, the term *canvas stitch* is never definitive, being used both as a generic term for all stitches used in 'canvas work' and as a specific term for practically any one of them.

DOUBLE-FACED (OR 'TWO-SIDED') CROSS-STITCH Most *crossed stitches* have vertical and/or horizontal stitches on the reverse (see figs. 354 and 355, p. 236, and figs. 365 and 366, p. 241); but there are different ways of working the standard *cross-stitch* so that the two faces are the same. If, for example, a single row of slanting 'stroke' stitches forms identical stitch series on the two faces (see *b*, figs. 354 and 355), the spaces between stitches can be filled in on the return trip (or 'second journey') to form identical zigzag lines sometimes described as 'diagonal running stitch' (see fig. 364, *a*). But it is equally possible, instead of filling the spaces on the second journey, to cross each of the original slanting stitches with identical stitches slanting in the opposite direction (fig. 364, *b*) and produce, on each face, identical series of 'spaced' *cross-stitches* (the crosses on one face alternating with those on the other). Furthermore, this can be repeated in two more 'journeys' so that there are identical rows of contiguous *cross-stitches* on the two faces. On the other hand, if the second 'journey' was used to form a zigzag line of stitches, third and fourth trips can be made to cross the slanting stitches of the first and second respectively. In other words, in *cross-stitch* (always a 'two-part' construction), series of crosses can alternate on the two faces of the material into which they are worked, or be contiguous on one face and lacking on the other; but by repeating the two-part construction, series of contiguous crosses can be produced on both faces in a four-part construction (often designated 'two-sided cross-stitch') which can be accurately described as *double-faced cross-stitch.*

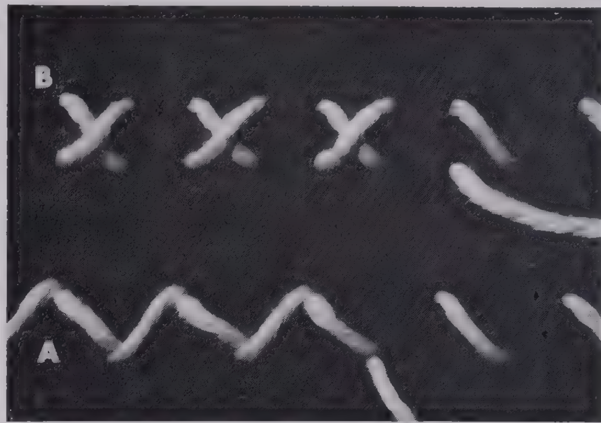

FIG. 364 Two 'second-journey' treatments of spaced 'stroke' stitches that are alike on the two faces of the fabric: a) filling in all spaces between stitches and forming identical zigzag lines on the two faces; b) crossing all stitches to form rows of spaced crosses, alternately placed on the two faces.

NOTE: that any *cross-stitching* in which the stitches are crossed on both faces may be described as 'two-sided' (a term widely used in the literature of embroidery apparently to indicate duplicate stitches on the two faces of a fabric), but the term *double-faced* can be used, as in fabric terminology generally, to specify that the structure is *identical* on the two faces.

'LONG-ARMED' CROSS-STITCH There are various extended and progressively *crossed stitches* whose crossed segments form neither distinct units nor the diagonals of a square. Closely related in both appearance and structure, they tend to fall into two general categories; although their many different forms are designated in a confusing variety of ways. The characteristic common to all these stitches is the multiple, progressively-interworking relationship between stitch segments, as contrasted with the single, static, unit crosses of standard *cross-stitch*; that is, one arm of the cross is always longer than the other, and each stitch segment on the face of the work not only crosses another but is crossed by a third. Nevertheless, the reverse of the stitches offers a clearcut and usually verifiable basis for differentiation. According to the way the stitches are taken, those on the reverse may be vertical (i.e. across the line of progress of the stitches, see fig. 366, *b*) or they may be horizontal (i.e. parallel to the line of progress,

fig. 366, *a*). A stitch exhibiting the latter characteristic is usually referred to as 'herringbone stitch' (a peculiarly inappropriate name, in view of the other uses of the term *herringbone* in reference both to fabric structure and to pattern) but may also be called 'witch stitch,' 'catch stitch,' 'plaited Algerian stitch,' and if the 'reverse' (e.g. *a* in fig. 366) is being used as the 'face,' 'double back stitch,' 'crossed back stitch,' and sometimes 'shadow stitch.' Stitches exhibiting the former characteristic (e.g. fig. 366, *b*) are more consistently construed as variations of *cross-stitch* (although often only within specified limitations) and are variously referred to as 'long-legged' or 'long-armed' *cross-stitch*, 'plait stitch,' 'Spanish plait stitch,' 'plaited Slav stitch,' and so on. However, it should be noted that, of these five terms, only the first two are descriptive of both the stitch and its presumed derivation; while the third, which suggests its surface structure and appearance (if 'plait' connotes *oblique interworking*) would apply equally well to the stitch usually differentiated as 'herringbone stitch.' The last two terms add the limited identification of certain recognized areas of use.

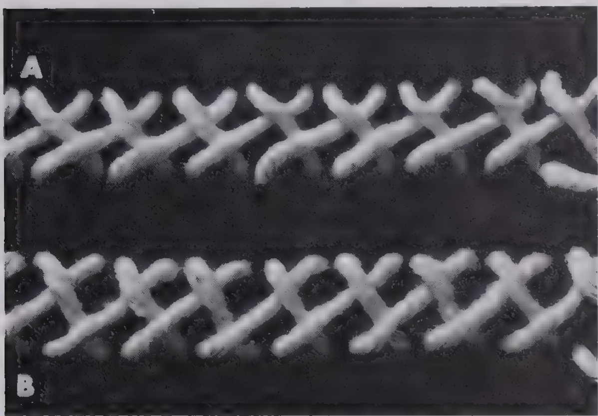

FIG. 365 Two differently worked series of progressively *crossed stitches*: a) often designated 'herringbone stitch'; b) usually described as 'long-armed' or 'long-legged' *cross-stitch*.

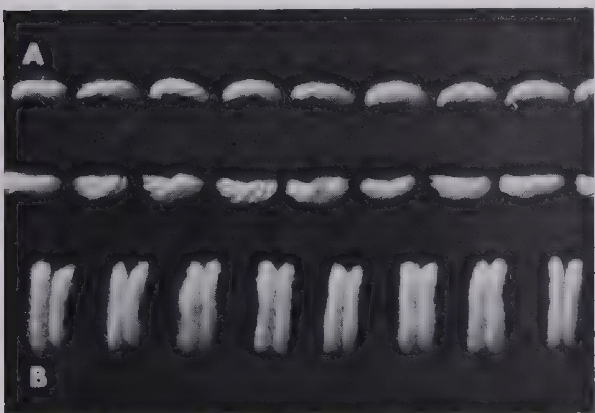

FIG. 366 Opposite face of fig. 365, showing the difference in the way the stitches are worked: a) stitches parallel to the line of progress of the work, sometimes called 'double' or 'crossed' *back stitch*; b) stitches at right angles to the line of work.

2. LOOPED STITCHES

All *flat stitches* are in a sense 'straight' stitches, that is, the sewing element is carried straight from the point where it emerges from the fabric to its next point of entry, and it is solely by variation of the location of entry and exit points that the arrangement of stitches and the appearance of the stitchery is varied. But if the element is made to deviate from the direct line and is held out of line by the next stitch, a *looped stitch* is formed. *Looped stitches* have been defined as 'flat stitches pulled out of the straight and forced into a loop,' or 'pulled to one side by looping the thread under the needle.' The basic form and presumably the prototype of *looped stitches* is the stitch commonly known as 'buttonhole stitch' which can be used as an edge finish, for outlining, and for 'filling,' either 'solid' or 'detached.'

BUTTONHOLE STITCH The *accessory stitch* usually called 'buttonhole stitch' (see fig. 367) is identical in constructional movement with the fundamental *single-element* structure usually designated *simple* (or *buttonhole*) *looping* (see fig. 9, p. 31; and pp. 45 and 46 for discussion of the term). The stitch is sometimes differentiated from, sometimes identified with, so-called 'blanket stitch.' Both names derive from the particular application of the stitch which may have been its primary use as a *functional accessory stitch*, viz., finishing and/or strengthening an edge. The most common criterion for differentiating between the two is the proximity of the stitches, but it is not consistently used, and the stitch in figure 367, when used as an edge finish, is variously described as 'buttonhole stitch,' 'blanket stitch,' 'spaced buttonhole stitch,' or 'spaced blanket stitch.' However, the wide-spread use of the term *buttonhole stitch* for the *simple-looping* structure both in lace-making and in 'detached embroidery' has led to quite general acceptance of that term for any form or use of the same basic stitch (which might well be called 'simple looping stitch').

When the stitch is worked into a fabric, whether in a straight line (fig. 367, *a*) or to 'fill' an area (fig. 368, *a*), the part of the structure on the reverse of the fabric appears as a single straight stitch (fig. 367, *b*) while the part on the surface is pulled out of line to form two sides of a hollow square. But if, when used for 'filling,' the stitches are attached to the fabric only at the edges of the area filled, the stitch itself although usually described as 'detached buttonhole stitch' is actually an *accessory* 'simple looping stitch' (fig. 368, *b*) and its structure is identical, except for the points of attachment at the edges of the area, with its *single-element* counterpart (fig. 9, p. 31) wherever found, from ropework to needle-made lace.

NOTE: that a single line of *buttonhole stitches* worked into a fabric may serve as a first row (the attachment to the fabric) for other more elaborate forms of *looping* (*loop-and-twist, cross-knit looping, knotted looping*, etc., qq.v.) when used as 'detached' filling stitches. Since the basic *looped* stitches and *knotted loops* are classified as *single-element* structures and illustrated in that section (pp. 31 ff.), their *accessory* use is not illustrated here.

FEATHER STITCH Working a vertical column of single *buttonhole stitches* (fig. 369) produces an asymmetrical series of stitches which has at times been described as 'coral stitch' (e.g. Caulfeild and Saward, 1882, p. 179); but if the stitches are worked first to one side of the vertical line and then to the other (fig. 370), the stitch is usually known as 'feather stitch.' Both these stitches can be construed as *variant uses* of *buttonhole stitch* (or *simple looping*) and obviously either one can be elaborated and extended in many ways.

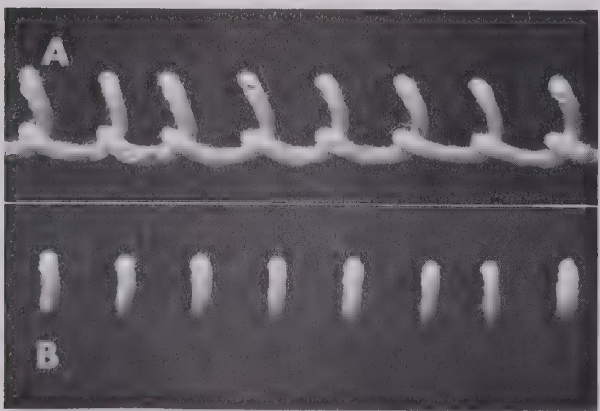

FIG. 367 A single horizontal row of *simple looping*, or *buttonhole, stitches* worked into a fabric: a) showing how the part of the loop on the surface is shaped; b) showing the short straight vertical segments on the reverse.

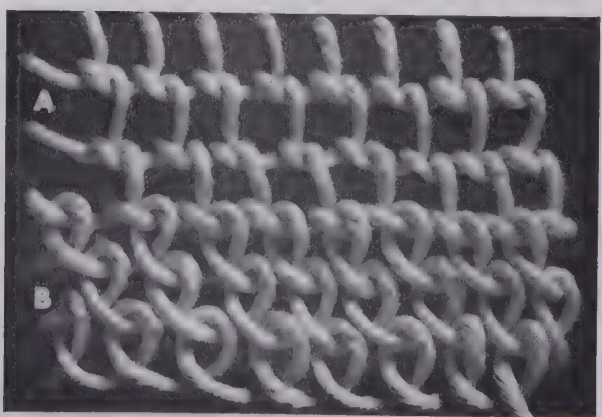

FIG. 368 a) Use of the stitch in fig. 367 to 'fill' an area. b) Detached use of the same stitch.

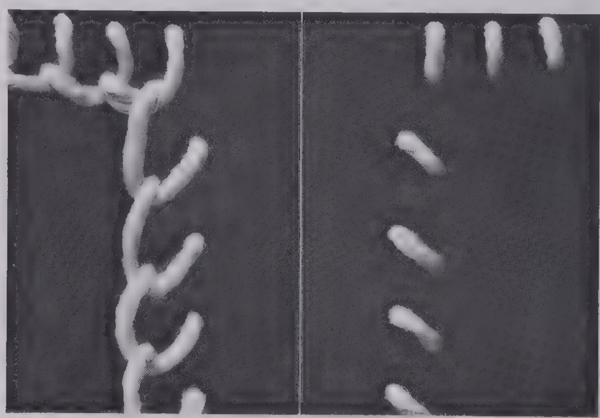

FIG. 369 Face and reverse of *simple looping*, or *buttonhole, stitches* worked horizontally and vertically.

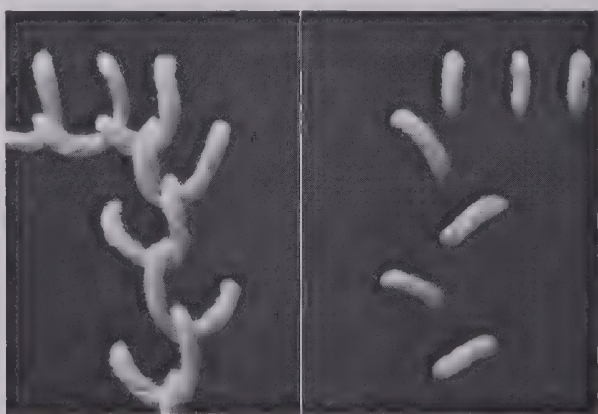

FIG. 370 Face and reverse of *simple looping*, or *buttonhole, stitches* worked first to one side of a vertical line and then to the other in what is usually designated *feather stitch*.

CHAIN STITCH If the loop of a *buttonhole stitch* is completed, that is, if the needle having formed the loop enters the fabric at approximately the same point from which it emerged (see fig. 371), the stitch is that known as 'chain stitch.' In its basic form the straight stitches on the reverse form a continuous line in the direction the stitch progresses (fig. 372). There are innumerable variations and variant uses of the stitch, many of which involve differences not only in the proportions and shape of the loop on the surface but also in the relative direction of the straight stitches on the reverse. But in this, its simplest and most common form, it is widely used for both outlining and filling.

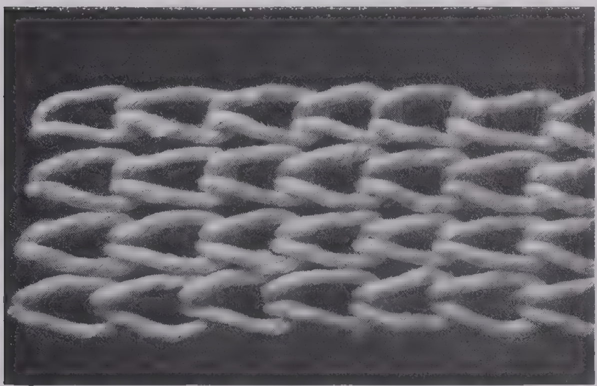

FIG. 371 *Chain stitch*, a *simple looping stitch* in which the element on the surface forms a completed loop.

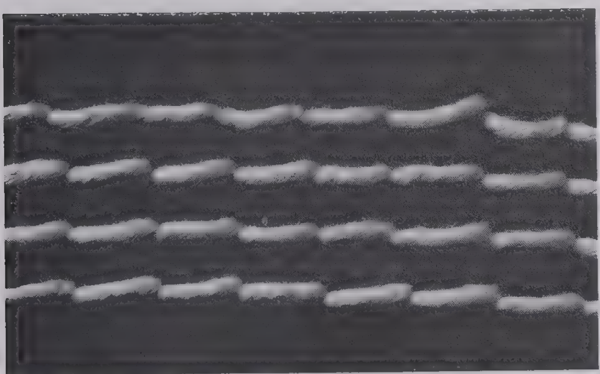

FIG. 372 Reverse of fig. 371, showing the straight contiguous segments that carry the element from the completion of one loop to the start of the next.

NOTE: that so-called 'split stitch' should not be confused with *chain stitch* which it may resemble in surface appearance. *Split stitch* is a *flat stitch* which can better be described as a form of *stem stitch* (see p. 239) in which the 'back stitch,' instead of emerging from the fabric either above or below the surface segment and causing it to slant, pierces it and splits the thread.

CROSS-KNIT LOOP STITCH The structural (but not constructive) identity between the form of *interlooping* known as *crossed knitting* (pp. 41 f.) and the form of *looping* called, in this volume, *cross-knit looping* (p. 32) has been noted, and also the variety of terms used to designate this structure in its various applications including embroidery (see pp. 47 f.).

As an embroidery stitch, it is when used for 'detached filling'– that is, when *single-element cross-knit looping* (fig. 12, p. 32) is used, as an *accessory stitch*, to cover an area of fabric, without being attached to it except along the borders of the area – that the structure is identical with its counterparts in *looping* and *interlooping*. The chief embroidery term for this, *Ceylon stitch*, has no literal significance, but either the term *accessory cross-knit looping* or *cross-knit loop stitch* would identify both the structure and its application. Worked into the fabric as well as round the cross of a previous stitch, the stitches can be constructed either in vertical columns (single, double, or multiple), or horizontally, and can be used to 'face' areas of any size. The use of *cross-knit loop stitches* for 'solid' filling was important in pre-Spanish Peru but seems to have no recognized and recorded counterpart in historic or present-day embroidery. Certain vertical-column uses, however, are well known. Used in a single column (fig. 373), for example, it is usually described as 'Vandyke stitch,' although the term is not definitive since it often connotes chevron patterning and refers to different stitch structures.

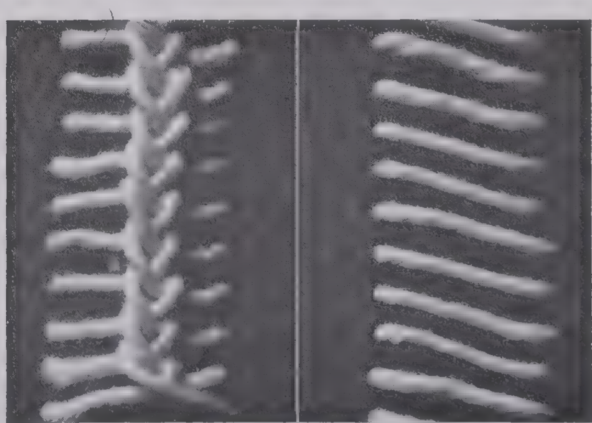

FIG. 373 Face and reverse of a single column of *cross-knit loop stitches*. Each is worked round the cross of the stitch above and only into the fabric at the extremities of the 'arms,' although it can also be worked into the fabric as it passes round the previous stitch.

3. KNOT STITCHES

Knotted looping was defined (p. 34) as "a single-element looped structure in which the loops are secured by knots" and it is clear from the subsequent discussion that the *knotted looping* type of structure, like other forms of *looping* and *interlooping*, may serve as an *accessory stitch* – especially for 'detached filling' and 'edge finishing.' Typical of the *accessory* use of the structure are various forms of what is usually called 'knotted buttonhole stitch' (see *knotted buttonhole loop*, fig. 24, p. 36), in which the form of the knot and its position in relation to the rest of the stitch may vary, as well as the particular application of the stitch and the name given to it (e.g. *tailor's buttonhole stitch, Antwerp edge, knotted buttonhole filling*), but which is always, basically, a *looped stitch* in which the loop is secured in some way by a *knot*.

In the term *knotted looping*, the primary reference of the word *knot* is to a tie or fastening, and any implication of the characteristic accompanying knob or protuberance is incidental. But when the sole function of an *accessory stitch* is to form a 'knob' on the surface of the fabric, the stitch can be differentiated from *knotted-loop stitches* by the designation *knot stitch*. The term *knot stitch*, then, would refer to certain non-functional stitches which produce certain visual and tactile effects. There are many such 'knot' structures – often rather alike in appearance even when differently constructed and designated – among them, the familiar 'French knot' (also known as the 'Pekin knot,' or simply as the 'knotted stitch') and the so-called 'bullion knot' (fig. 374).

FIG. 374 Detail (x1⅓) of fragment of Chinese embroidery in so-called 'French (or Pekin) knots' on silk damask. Below, two 'French' and one 'bullion' *knot stitches* (x1⅓).

Variant Uses of Stitch Structures

DETACHED STITCHES When stitches of any kind are used to cover an area of fabric without being attached to the fabric except along the borders of the area (being worked into previous stitches rather than into the fabric), they are probably best described generically as 'detached' stitches (see p. 242). They are, in a sense, used to construct a separate fabric (often akin to lace structures) and consequently the *linking, looping*, and *knotted-looping* fabric structures of *single-element* and *two-single-element* construction are peculiarly adaptable to this *variant use* of stitches. But it is also possible to use long straight stitches to construct a framework or foundation on which a second series of stitches can be worked in various types of fabrication related to the interworking of weft with warp (e.g. *interlacing* or *wrapping*). In its simplest form, this produces the equivalent of *plain weave*; and when plain *running stitches* interlace long straight stitches 'laid' in the opposite direction, the work is usually designated *detached darning* (see fig. 375), but may also be described as 'detached interlacing,' 'detached running stitch,' or 'surface darning.' (See pp. 54 f. for a 'detached' use of *wrapping*, or *stem stitch*, sometimes described as 'surface crewel.')

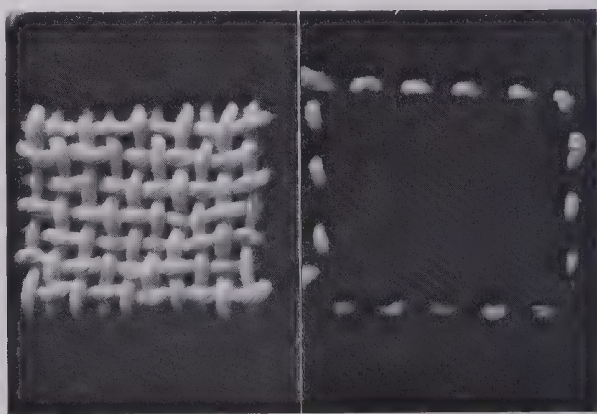

FIG. 375 Face and reverse of a small square area of so-called 'detached darning,' sometimes also described as 'surface darning,' et cetera.

NOTE: that although the terms *detached* and *surface* are often used interchangeably, *surface* is also quite differently used. Prefixed to the name of a stitch, the term *surface* may be used to indicate that the stitch is worked in such a way that the bulk of the embroidery thread is on the face of the fabric, as, for example, in 'surface satin stitch' (more commonly known as *false satin stitch*, see

fig. 357, p. 237) and in 'surface running stitch,' the technique of which is often called 'surface darning' (see fig. 352, p. 235) as is, less felicitously, the 'detached' construction in figure 375 above.

COMPOSITE STITCHES The stitch structures usually described as 'combined' or 'composite stitches' are often construed not as combinations of stitches but as entities which constitute a separate category of stitch structures. But since the distinguishing characteristic of these structures is that they are made up of two or more component stitches, the structure of a so-called 'composite stitch' is not actually a separate 'stitch' but represents one particular correlated use of two or more individual stitches, that is, a combination of stitches which can be analyzed and described in terms of its component parts. Nevertheless, many such combinations have acquired specific 'stitch names,' comparatively few of which, unfortunately, suggest either the composite nature of the structure or the identity of the components.

As the general heading for one category of stitch structures, the term *composite stitch* is used to refer to almost any complex of different stitch structures in which one stitch or series of stitches is superimposed on a different stitch or series. One of the simplest possible combinations is commonly and descriptively designated 'whipped running stitch' (fig. 376, *a*), a term which is self-explanatory; while in a slightly more elaborate combination, widely known as 'Pekinese stitch,' simple *buttonhole loops* are worked into a foundation line of *back stitch* (fig. 376, *b*).

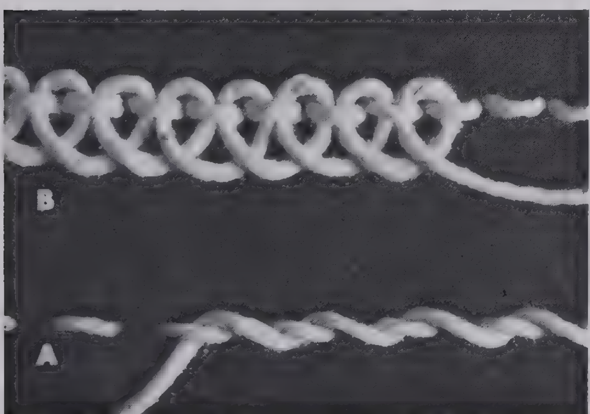

FIG. 376 a) 'Whipped running stitch'; b) so-called 'Pekinese stitch,' in which a line of *back stitch* is used as the foundation for *buttonhole loops*. On the reverse of both, only the foundation stitches appear.

NOTE: that two-part stitches that are composed of identical stitches worked in separate 'journeys' (e.g. *double running stitch*, p. 235) are seldom classed as 'composite' even when the second series of stitches is superimposed on the first (e.g. *cross-stitch*, fig. 354, *d*, p. 236, and fig. 364, *b*, p. 240).

Elaboration of *composite stitches* takes many forms: either stitch series may be elaborated, or both – or a third series may be added. Working intersecting lines of stitches in a lattice-like structure is one common way of elaborating the foundation, which may then be interworked in ways varying in complexity from simple *interlacing* to elaborate forms of *looping* or *knotted looping*. Then again a simple series of long straight stitches 'laid' across an area may serve as a foundation on which threads can be *interlaced*, *looped*, *wrapped*, or *knotted* in an endless variety of ways. Obviously many 'composite-stitch' structures involve a 'detached' use of stitches (the *buttonhole stitches* in so-called 'Pekinese stitch' are actually 'detached') just as many 'detached-stitch' structures are 'composite.' (For example, 'detached stem stitch,' sometimes called 'surface crewel stitch,' would necessarily be 'composite,' while 'detached buttonhole stitch' would not.)

PILE STITCHES An *accessory element* can be used to add *pile* to a foundation material. The *pile* can be constructed by *sewing* – that is, by means of *accessory stitches* – with the *pile* formed by leaving free loops at certain points in making 'tent stitch,' for example, or 'cross-stitch.' One such pile-forming stitch (associated with so-called 'Berlin work,' v.i.) is sometimes designated 'plush stitch'; and the *sewing* method was also used in the 17th and 18th centuries to imitate 'knotted carpets' in the needlework known as 'Turkey work' (for discussion of so-called 'Smyrna stitch,' see p. 227). So-called 'candlewicking' was originally worked with a needle, with candlewick yarn used to form a pattern or surface of loops or tufts — a technique much used for so-called 'candlewick' or 'tufted' bedspreads.

NOTE: that *accessory pile* can also be produced by drawing loops of an *accessory element* up through a foundation material by means of a hook (i.e. by 'hooking') – a technique probably best known for its use in so-called 'hooked rugs.' (Note too that a hook is used instead of an eyed needle in the so-called 'chain stitch embroidery' usually described as 'tambour work.')

Notes on the Use of Terms

The fact has been noted (p. 234) that *stitch* structures that are *accessory* to a fabric are almost completely free of restrictive requirements, free alike of any need for structural coherence and of the necessity of conforming to the essentially right-angled arrangement imposed by the loom – a freedom which leads naturally to almost infinite multiformity of possible stitch structures and in turn to extreme multifariousness of terms. To a large extent the only structural limitations on the use and nature of *accessory stitches* are those imposed by the nature of the *accessory element* itself and of the fabric into which it is worked, and to a lesser degree by the projected use of the finished product.

The lack of structurally restrictive requirements leaves each individual craftsman quite free to develop not only his own stitches, and variations of stitches, but his own way of working the familiar ones; and the range and variety of different terms for one stitch often reflect not only variety in the way the stitch is used, and in the results achieved with it, but also variety in individual working habits. Often a presumed relationship between stitches, and a subsequent naming of one stitch in terms of another, has been based on quite individualistic ways of handling needle and thread; and this is another persistent source of overlapping and contradictory nomenclature.

Although needlework, both decorative and functional, has been extensively and commonly practiced in all ways of life from the earliest times, its decorative use, particularly, has been recurrently marked by the development in different places of highly specialized styles and applications. It is basically one of the simplest crafts, a homely activity that can be practiced by almost anyone on almost any material. But, with fine and carefully chosen materials plus a high degree of skill and imagination in handling them, needlework can be raised almost to the rank of a fine art. And this extreme range of use, application, and degree of refinement is also reflected in the endless variety of the terminology of the craft.

NAMES OF 'STYLES' OF EMBROIDERY

In addition to the variety of terms generated by the individualistic nature of needlework, the general subject of *embroidery* (decorative needlework) is often divided – for purposes of study and discussion – into modes or 'styles' of 'embroidery work' (e.g. 'canvas work,' 'cut work,' 'laid work'); and *embroidery stitches* are often grouped (and said to be 'classified') according to the 'styles' with which they are associated. Different embroidery 'styles,' or modes of 'embroidery work,' are characterized by certain distinctive qualities of texture and often by qualities of design and perhaps of color – which may entail the use of specific ground fabrics, embroidery threads, and stitches. But even when characterized by some special application of certain stitches, 'styles' are seldom differentiated on the basis of the stitches used.

Canvas work · Tapestry work · Berlin work

So-called 'canvas work' (sometimes defined as synonymous with 'tapestry work') is usually characterized by the allover use of various *straight* and *crossed stitches* on a special kind of fabric usually identified as 'canvas'; and many so-called 'canvas stitches'– 'tent stitch' and 'Gobelin stitch,' for example – are specially defined, and are differentiated from each other, in terms of the number of threads of the canvas encompassed by each stitch. But there are no stitches that are used solely in 'canvas work'; and descriptions of 'canvas stitches' are in fact descriptions of a restricted and specialized use of stitches which have other applications. When *embroidery* is described as being 'on counted threads,' a precision in the use of stitches similar to that typical of 'canvas work' is indicated, but presumably there is no analogous implication of allover surfacing or of any special fabric base or thread. 'Berlin work,' on the other hand, was a name current in the 19th century for an even more specialized use of canvas and of certain stitches, and the term usually implies the use of so-called 'Berlin wools' and often of specially prepared patterns as well.

NOTE: that the term *raised Berlin work* refers to the use of eyed needle and (usually) wool yarn to produce loops or a pile-like construction on canvas or other suitable base material. The type of work is also described as 'raised or clipped wool-work,' as 'raised cut embroidery,' as 'embroidered' or 'needle-worked' pile, and so on. The

stitch may vary in certain details and is described in terms sometimes of 'tent stitch,' sometimes of 'cross-stitch' (with explanation of the point at which the loop is formed), and sometimes as a specific stitch (e.g. 'knotted stitch – single,' see p. 227).

Crewel: Embroidery · Yarn · Stitches · Stitch

The term *crewel* is variously used: to refer to a style of embroidery (usually but not necessarily to worsted embroidery on a linen ground), to a type of embroidery yarn, to the stitches used in 'crewel work,' and to one specific stitch commonly associated with crewel embroidery but more often called *stem stitch* (q.v.). But since what is known as 'crewel embroidery' requires no special stitches or adaptation of stitches, describing certain stitches as 'crewel' stitches will actually specify nothing about them except that they are used in that general type of embroidery.

Couching · Laid work · Self-couching

Although there is general agreement about the nature of both 'couching' and 'laid work' as methods of fabric embellishment, there is some difference of opinion about the exact application of the words, particularly *couching*. It seems to be more or less agreed that both terms, *couching* and *laid work*, refer to a two-part method of embroidery, that is, to a method which involves *accessory elements* in two ways: one consists of 'laying' an element on the surface of a fabric in long stitches secured only at the ends; the other, of tying down, or 'couching,' these elements with series of short stitches. But in the various distinctions that are made between so-called 'laid work' and 'couching' as 'styles' or methods of embroidery, the delimiting differences vary so much that none of the differentiations proves particularly valuable. Somewhat more useful, however, is the practice of differentiating not between two styles or methods but between the actions of 'laying' and 'couching' as components of a highly variable single method – the practice, that is, of describing the long surface threads as 'laid' and the shorter tying-down stitches as 'couching.' Thus the 'laid' threads are said to be 'couched' by the 'couching stitches,' but while there is probably no stitch that cannot be used for 'couching' and be properly described as a 'couching stitch' when so used, there are no 'couching stitches' as such.

One of the advantages of 'couching' as a style or method of embroidery is that it permits the decorative use of threads and cords that are either too stiff or heavy to be effectively worked through a fabric or too precious for any part to be wasted unseen on the 'wrong side,' and of elements to which beads or other *accessory objects* have been attached (see p. 254). A single cord (or a small group of elements) may be 'couched' for lines or outlines; or many elements may be 'laid' side by side, to completely surface an area. The surface of 'laid' stitches can be 'couched' by more than one element in more than one series of the same or different stitches; and it is also possible to 'lay' threads at intervals in two or more directions and 'couch' their intersections with decorative stitches. Obviously, enumeration of the possibilities of varying the number, nature, direction, and spacing of the 'laid' threads, and the placing, structure, variety, and number of the 'couching' stitches, is out of the question. It is clear, however, that while the action of 'couching' represents a *variant use* to which stitches may be put, in specific examples, a combination of 'laid' and 'couching' stitches may be construed as a 'composite stitch,' or as a kind of *appliqué* (q.v.) of the 'laid' elements.

Although, customarily, different elements (often of different quality and/or color) are used for the two functions of 'couching,' or 'laid work,' in certain stitches the same element is used for both, being first 'laid' across the area to be covered and then used, as it returns to its starting point, to 'couch' the 'laid' segment. This is sometimes differentiated from 'couching' proper and described as 'self-couching.' (The stitches called 'Bokhara couching' and 'Roumanian couching' are examples of 'couching' in this sense.) Many varieties of 'couching' are differentiated according to the stitch used for the 'couching' (e.g. 'cross-stitch couching'), many according to the patterns formed by the 'couching stitches' (e.g. 'diamond couching'). Some are designated by terms descriptive of some general or specific visual effect, and others, of course, by the name of a geographic area of use.

Cut work · Drawn work

The terms *cut work* and *drawn work* both refer to kinds of 'openwork embroidery,' each of which has

been described as the 'earliest' or the 'original' form of lace (or identified as its 'forerunner'). The two terms may or may not be differentiated from each other, and if they are, the lines of demarcation tend to vary. *Cut work* is perhaps the more inclusive term and is sometimes simply identified as the 'early name' for *drawn work*. On the other hand, there are some who distinguish two types of *cut work* (e.g. Huish, 1913, p. 161), one related to lace, the other to so-called 'drawn-thread embroidery.'

The significant characteristics of the general type of work comprehended by these two terms are: first, that parts of the ground fabric are cut away or withdrawn; and second, that *stitches* are used both to prevent fraying of cut edges and to embellish the whole by reworking bared elements or refilling cut-out spaces. The differences are to be found in the amount and manner of the removal of elements or areas of ground fabric, and in the type and use of *stitches*.

On the basis both of how much and what parts of the ground fabric are removed, and of how stitchery is applied to and between the remaining areas, it seems possible to differentiate three general types. In one, areas of fabric are cut away, the cut edges overcast or oversewn in some fashion, and the spaces filled with *looping* or other 'lace stitches' (see p. 45) of varying degrees of elaboration. In a second type, certain warp and weft elements are cut away from certain areas, with a few left at intervals in both directions as connecting threads; cut edges and supporting threads are then oversewn, and further stitchery may be added including 'lace filling' stitches. In the third type, the elements of only one set are withdrawn from any one area and the remaining elements serve more or less as warp elements on which a *sewing element* is worked, sometimes in regular embroidery stitches, but often more as a weft element might be — that is, *wrapping*, *knotting* about, or *interlacing* the bared elements (which are sometimes crossed in a simulation of *gauze weave*).

Of these types, the first two are sometimes grouped together as *cut work* when *cut work* is differentiated from *drawn work*; but, on the other hand, both may be construed as *drawn work* and the third type differentiated as 'drawn-thread work.' It should be noted, too, that the term *cut work* sometimes refers (19th century usage particularly?) to *appliqué* (see p. 251), and also that a relationship between *cut work* and fabric 'inlay' (p. 252) has been remarked — the cut-out fabric being replaced in *cut work* with *stitches*, in 'inlay' with other fabric.

NOTE: that in a simpler type of openwork embroidery, generically referred to as 'eyelet embroidery,' the edges of small openings (usually produced by piercing the foundation material with a bodkin or stiletto) are overcast or 'buttonholed.'

PART THREE

Structures Accessory to Fabrics

II ACCESSORY FABRICS AND FABRIC COMPLEXES

III ACCESSORY OBJECTS

II ACCESSORY FABRICS AND FABRIC COMPLEXES

Stitches added to a fabric are *accessory* to it, and the resulting total construction is a repaired, reinforced, embellished, or otherwise 'worked' fabric; but when *fabric* is added to fabric, the result is in a sense a composite fabric or a *fabric complex*. Fabric can be added in many ways, for many purposes, and the resulting *fabric complex* can vary in the nature of both *ground fabric* and *accessory fabric*, in the proportion of one to the other, in the relationship of one to the other, and in both the means and the manner of attachment of one to the other. What is more, in such *fabric complexes* there is frequently more than one *accessory fabric*, and if (as is usual) the fabrics are attached by means of *stitches*, the stitchery constitutes still another *accessory structure* and it, too, is widely variable (see ACCESSORY STITCHES, pp. 232 ff.). In view of the extremely heterogeneous as well as adventitious nature of the use of *accessory fabrics*, the subject will be surveyed very briefly, in very general terms, and without discussion of the diversity of nomenclature likely to be encountered in specific references to the diverse constructions.

A. Structures

Although the structure of any *fabric* may be related to its use (and may have been adapted specifically to the intended use), there is nothing inherent in any fabric structure that necessarily affects its usefulness as an *accessory fabric*. Fabric structures of all kinds are found in *accessory-fabric* use, and while the fact that one fabric (or part thereof) has been added to another is an obviously significant factor in the *fabric complex*, it in no way affects the nature of any component fabric. Adequate structural delineation of a *fabric complex* entails description of the structure of each component *fabric*, and of any *stitch* structures by means of which they are attached to each other.

B. Uses

Accessory fabrics can be used, as *accessory stitches* are (see p. 233), to serve either functional or decorative purposes, but in many instances a functional combining of fabrics is used as a vehicle for decorative design. The functional uses of superimposed fabric range from *repair* in the form of patches, to *reinforcement* and augmenting in the form of lining, padding, binding edges, and so on; and when *seaming* is used to add fabric to fabric without superimposition, fabrics can be increased in area and their shapes modified in innumerable ways. The decorative uses are seldom completely separable from the functional; in a *fabric complex*, a use of fabric that is largely functional may be combined with a largely decorative use of stitches, while often enough the sole use of stitches is to effect a decorative use of fabric.

C. Interrelationships

Fabric can be added to fabric in various proportions and in three essentially different ways. In other words, the fundamental relationships between the component fabrics of a *fabric complex* fall into three general categories – namely, fabrics superimposed on others, 'set in' others, and seamed one to another – and the basic ratio between constituent fabrics can vary with the type of interrelationship and also within each type.

1. SUPERIMPOSED

One of the simplest and most obvious ways of adding fabric to fabric is by *superimposing* either proportionately small or exactly equivalent areas of *accessory fabric* on a ground fabric. The former is both widely used and widely varied and in its most utilitarian form is called 'patching'; when used decoratively, it is usually termed *appliqué*, but is sometimes described as 'cloth work,' 'cloth embroidery,' et cetera. Superimposition of equivalent areas of fabric one on another, with or without padding between the layers, is nearly always utilitarian to some extent, as in lined garments, padded armor, quilts, et cetera. When decorative as well, the decorative qualities are often contributed largely by the stitchery.

A. APPLIQUÉ

Decorative applied work, or *appliqué*, is of two sorts: 'overlaid' (sometimes called 'onlay') in which pattern is produced by shaped sections of *accessory fabric* which are laid on the face of a complete ground fabric and fastened to it (usually with stitches but sometimes with adhesives); and 'underlaid' in which the pattern is produced by applying the *accessory fabric* under a ground fabric from which the pattern areas have been cut.

Patterning a ground fabric by superimposing areas of *accessory fabric* is closely related to patterning by means of areas of 'detached stitches' when the stitches are used to simultaneously produce a fabric structure and superimpose it on a background fabric. The chief difference lies in the pre-existence of the *accessory fabric* and the independence of the means of attachment which, if it is stitchery (rather than an adhesive), constitutes an additional *accessory structure*, the complexity and visibility of which are widely variable. If the stitchery is purely functional, it will be made as nearly invisible as possible, but if not it may, as has been noted, be so elaborated that the fabrics it serves to attach become merely a background for it.

Although the term *appliqué* is usually associated with the application of pieces of fabric cut to a desired shape, many examples can be cited of *appliquéd* fabrics that have been shaped in the process of construction. Among these the use, in ancient Peruvian fabrics, of shaped *cross-knit looping* constructions and of *tapestry-woven* disks may be noted, and also the application of shaped needle- or bobbin-lace constructions to machine-made net in 19th and 20th century European laces.

Decorative application of heavy cords to fabric is usually described as 'couching' (q.v.) but it is also sometimes classed as *appliqué*, as are many examples of the application of tape, braid, ribbon, and so on. The attachment of independently constructed fringes to the body of a fabric is a form of superimposition of fabric on fabric, although due to the nature of fringe, the *accessory fabric* is usually secured only along one edge and is sometimes associated with the *seaming* of fabric edges (v.i.) rather than with *appliqué*.

B. QUILTED

In reference to fabrics, the word *quilting* is usually defined as 'the action of sewing two or more layers of fabric firmly together with lines of stitching,' and thus refers to the 'application' or 'superimposing' of one fabric on another. However, the quantitative relationship between the fabrics differs from that in the work usually referred to as *appliqué*; and since the fabric components of *quilting* do not usually differ in size, the fact that one or more of them may legitimately be construed as *accessory*, and that *quilting* represents a particular use of *accessory fabric*, is not always conceded.

The word *quilt* apparently derives ultimately from the Latin *culcita*, meaning a bed, mattress, or cushion, and some association with 'bedding' is still implicit in the term. Although the association is by now perhaps more with bed coverings than with beds, definite connotations of padding or stuffing survive. The verb *to quilt* has come to be more specifically associated with the stitching than with any other aspect of construction; and one or another of the stitches most widely used for *quilting* (e.g. *back stitch*) is apt to be referred to ambiguously as the 'quilting stitch.' The stitches used for *quilting* always serve the very practical purpose of firmly integrating two or more separate layers of fabric in a *fabric complex*; but they may, at the same time, be used for decorative purposes – perhaps for elaborate (even pictorial) representation, or merely to provide the richness of a patterned background for other embroidery that is purely decorative or for *appliqué*.

NOTE: that there are certain loom-woven fabrics with a comparable appearance of being composed of layers of fabric held together by lines of stitching (or of being 'stuffed') that are sometimes designated 'quilted weaves' (e.g. matelassé).

2. SET IN (INLAY)

Equally akin to 'overlaid' and 'underlaid' *appliqué* is so-called 'inlay,' in which shaped pattern-segments of *accessory fabric* are not laid over or under the coherent ground fabric, but are set into it. That is, carefully cut segments of *accessory fabric* are set into identically shaped openings which have been cut out of the ground fabric. This customarily involves stitchery, the stitchery tending to be purely functional; but it is quite possible for both the background fabric and the 'inlaid' segments to be secured to a 'lining' fabric by means of adhesives. Although the technique of *setting-in* pieces of fabric may be of practical use in shaping garments, for example, or for patching when worn areas must be replaced rather than merely covered, 'inlay,' more than the other modes of using *accessory fabrics*, tends to be largely decorative.

3. SEAMED TOGETHER (PATCHWORK)

In almost any general area of fabric use, examples can be found of *fabric complexes* produced when the area of a fabric is extended in the same plane by *seaming* (see p. 233) other fabrics to it. Fringes and other fabrications can be seamed to the edges of fabrics to add length and/or width as well as embellishment; and since it is fabric width rather than length that is usually restricted by the loom, the side selvedges of several loom-widths are often *seamed together* when greater total width is required. (Many hand-woven rugs, spreads, and hangings, for example, are made up of a number of perhaps twenty- to thirty-inch widths; and many African aboriginal fabrics are woven only three to perhaps nine inches wide, a number of widths being seamed together to make large mantles often a yard and a half or more across.) But when pieces of fabric, rather than complete widths or lengths, are seamed together, the component parts are usually much smaller in relation to the composite whole and the work is commonly described as 'patchwork.'

The distinction between so-called 'patchwork' and 'inlay' is also, in part, a matter of proportion – in part, one of equivalence. In *inlay*, there is a complete foundation fabric out of which pieces are cut and into which pieces of other fabrics are subsequently set; whereas in *patchwork*, a fabric complex may be said to be assembled by *seaming together* many relatively small and usually more or less equivalent pieces of a number of different fabrics. The *seaming stitches* whether or not decorative (or covered by other fabrics or by stitchery) constitute an *accessory structure*; and still another fabric is added to the complex when *patchwork* is 'backed' or 'lined' (a customary way of hiding the many seams).

Patchwork is often almost totally utilitarian – providing, as it does, a means of constructing a usable fabric out of fragments too limited in size for individual usefulness – but with proper selection, shaping, and arrangement of the individual pieces a highly decorative fabric may be put together. *Patchwork*, then, like *appliqué* and *inlay*, can be used as a purely decorative technique, and like them can be supplemented with decorative stitchery.

NOTE: that in the fabric context, the word *patch* usually refers to a relatively small piece or 'scrap' of fabric – the term *patchwork* referring to a form of so-called 'fancywork' in which diverse 'patches' are sewed together (often in a pattern) to form a flat surface, the term *patching* to a form of mending in which a hole or worn spot is covered by a 'patch.'

Detail of multi-colored many-layered cotton *appliqué* shirt made by the San Blas Cuna Indians of Panama.

III ACCESSORY OBJECTS

The diversity of *objects* that are added to fabrics – usually but not necessarily as embellishment – is almost unlimited. Small objects varying widely in shape, size, source, and general nature are to be found attached to fabrics of all kinds in a variety of ways and in endlessly variable arrangements. Selection, application, and arrangement of such adjuncts vary according to availability, ingenuity, custom, taste, and so on. Practically any type of *fabric* or *fabric complex* can be used as a foundation for the attachment of suitable *accessory objects*; and while the selection of a means of attachment often seems to be related to the particular nature of objects and foundation, there is no consistent correlation; stitchery of some sort serves almost universally, and constitutes an additional *accessory structure*. The structural characteristics involved in the application of *accessory objects* to fabric – in addition to those of the *fabric* or *fabric complex* which serves as a foundation – are twofold: those inherent in the *objects* themselves, and those of the *stitchery* or whatever else may serve as a means of attachment.

In view of the variety of objects used to embellish fabrics and the diversity of techniques and styles that have been developed in the use of each, only a brief and generalized survey of possibilities is being offered – a survey limited to listing the general categories of widely used objects and suggesting something of the different means of attachment that have been devised for, or adapted to, the use of various objects and foundation materials.

A. Sources and Nature

The general sources are comprehensive: animal, plant, and mineral. The unaltered natural forms of such things as shells, small bones, teeth, tails, feathers, porcupine quills, seeds, leaves, and so on, may be employed; or parts may be selected for use – with or without special shaping. Large animal parts (including, for example, tusks and horns) are almost always shaped, and stone, metal, glass, and ceramic objects are presumably invariably worked in some way.

Objects worked and shaped for such use tend to fall into the general categories of beads, buttons, and flat plaques, while varying widely in size and exact conformation (from fairly large plates or plaques, for example, to tiny sequins). Coins, medals, bells, and rattles are used, also bits of mirror and precious as well as semi-precious stones. Fabric-related objects such as tassels, tufts, pompoms, et cetera, composed of fibers or fibrous elements, are often construed as *accessory fabric* rather than as *accessory objects*. Interpretation seems to depend largely on the nature and presence of associated *accessory structures*.

B. Means and Method of Attachment

An *accessory* thread-like *element* usually serves as the means of attaching *objects* to *fabric*, and the method is usually sewing, with *stitches* taken into the foundation fabric; although, if the foundation fabric is net-like in structure, the *accessory element* may simply wrap or tie round some part of the

object and also round some part of the openwork structure. (Feathers, for example, are often individually tied to a foundation of *knotted netting*, as are leaves.) Another method combines sewing and tying; that is, objects are secured to an *accessory element* (individually tied or strung in succession), and it, rather than the object, is sewn to the foundation – a method obviously akin to 'couching.' It should be noted, too, that in a quite different use (but often with quite similar effect) many objects (e.g. beads), instead of being used as *accessory objects* attached by an *accessory element*, are attached to a *fabric element* prior to or during the process of construction of the fabric. Since their attachment is to a *fabric element* (of which they may be considered components) and not to the completed fabric or to an *accessory element*, they do not constitute *accessory objects*. For example, although beads are often individually sewed to a foundation fabric, strung on a *sewing element* between the *stitches* that are taken into the fabric, or strung on an *accessory element* which is 'couched' to the fabric, they can also be strung on an element of fabric construction and as components of that element can be used in the construction of *single-element looping* or *looping on a foundation element*; in any oblique interworking of a *single set of elements*; or in the warp-weft interworking of *two or more sets of elements*.

Accessory stitches (*running stitch* and *chain stitch*); *accessory fabric* (*appliqué*); and *accessory objects* (beads, shells, sequins, buttons, and fringe) attached by *stitches*. Detail of an Apo Kayan 'girdle' from Borneo (T.M. 61.13).

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SOURCES OF INFORMATION

The following is a list of publications consulted as part of the study which resulted in the foregoing classification of fabric structures and critical commentary on terms. The list suggests the range and variety of possible sources of fabric information and of its widely variant nomenclature. It also indicates the variety of periods, geographical areas, and approaches essential to an over-all consideration of fabrics and a determination of their primary structures.

Although the present publication presents a single individual's concept of the basic nature and primary interrelationships of fabric structures, the concept was developed over a period of many years spent in seeking out, analyzing, and discussing not only diverse fabric structures and diverse points of view about their nature and proper classification but also the diversity of terminology. It would be manifestly impossible to enumerate all the publications that have influenced (positively or negatively) the development of the concept as now presented, but the following list includes most of those consulted in the initial investigation, and subsequently, in the course of formulating and expounding the classification, checking its validity against both published fabric descriptions and classifications of limited groups of fabrics, and attempting to correlate the terms used for fabric description with the structures to which they are applied. The investigation of sources was necessarily more random during the preparation of text and illustrations for the final presentation of the classification (first formulated in 1953, but not published), and on completion of the technical text early in 1962 the file of *Sources of Information* was closed.

The fact that it was primarily variety of techniques, terms, points of view, and usage that was being investigated rather than any one technical type, field, point of view, geographic area, or period of time is reflected in the heterogeneous nature of this list of sources. All the publications listed have been studied (at least in part), and excerpts from them make up the extensive file of definitions and fabric descriptions on which the discussions of terms are based. There are omissions (chiefly of reprints) due to inability to secure adequate bibliographical information, and undoubtedly some due to inadvertence. Many of the journals and published series cited contain a great deal more fabric information than could be examined in detail (the *Annual Reports* and *Bulletins* of the *Bureau of American Ethnology*, for example; *Ciba Review*; *Denver Art Museum Indian Leaflets* and *Material Culture Notes*; *C.I.E.T.A. Bulletin de Liaison*; *Handweaver and Craftsman*; *Bulletin of the Needle and Bobbin Club*; and so on). When it proved impractical even to list all of the issues and individual articles that were actually studied, one criterion for inclusion was uniqueness of terminology, point of view, or subject matter (fibers, techniques, areas, etc.).

Inasmuch as the purpose of the study was determination of structural bases for classifying fabrics, publications dealing wholly (or largely) with dyes, or with dyeing, printing, or painting of

fabrics (i.e. with the use of color as such) have not been included. Works primarily on costume have been included only to document the use of fibers or fabric types in certain areas or periods not otherwise covered; those primarily on looms and equipment only when the information they present contributes to an understanding of the structural nature of the fabrics they are used to construct. Textile 'glossaries,' 'dictionaries,' 'vocabularies,' and 'encyclopedias' are starred (*) if alphabetically arranged; the general dictionaries and encyclopedias most used are listed separately, as are a few publications on various aspects of language and usage.

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NOTE: that boldface numerals refer to pages on which mention or discussion of the entry is accompanied by illustration of it; enclosed in brackets, they indicate that the entry is illustrated but not mentioned in the text on that page.

The expression "definition of" indicates a specific statement (set apart from the text) of the meaning of the word; "defined" refers to less specifically formulated statements of delimitation, equivalence, or essential nature.

ADDENDUM

THE PAGE REFERENCES preceding each of the following paragraphs refer to the location of an asterisk in the text indicating where the new paragraph is intended to be read. If the asterisk appears at the end of a text paragraph, the material here is an addition. If the asterisk appears in the middle of a text paragraph, the material here is intended to replace the remainder of the paragraph.

p. 85, col. 2, line 3

* Terms like *Dema-Desh* or *Demirdash* (from the name of a village in Asia Minor) and expressions like *slit openwork, Peruvian openwork,* or *Peruvian lattice* seem meant to refer, at least at times, to a structure like that illustrated in fig. 114 but they are obviously not definitive.

p. 88, col. 2, 3rd line from bottom

* The analogy between any such patterning by means of discontinuous warps and the discontinuous-weft patterning that characterizes *tapestry weave* may seem to justify this one use of the always equivocal expression 'warp tapestry', but its use for any other kind of warp patterning is unwarranted.

It should also be noted that by combining the use of discontinuous warps with the tapestry-like use of discontinuous wefts it is possible to weave areas of solid color in a balanced or even a fairly open weave. This is sometimes referred to as 'warp-interlock tapestry', as 'warp and weft interlocking', as 'interlocked cloth', et cetera (see p. 90).

p. 90, col. 2, end of par. 2

* The term *warp and weft interlocking* (or *warp- and weft-interlocked cloth*) perhaps would come closer to satisfactorily describing the major characteristics of 'patterning by means of discontinuous warps and wefts'. However, since the joins in such fabrics are not necessarily interlocked, but may be dovetailed (especially the warps) or have sewn slits (especially between discontinuous wefts), the expression *discontinuous warps and wefts* added to the name of the weave (e.g. *plain weave*) and a description of the joins may be preferable.

p. 94, col. 1, line 10

* Another device for showing the diagonal in *weft-faced twill* is the use of a 2-color *double-faced 2/2 twill,* i.e. a twill in which one color produces a *2/2 twill* while another color alternates with the first to produce a second (complementary) *2/2 twill* on the same warps (fig. 277). Each weft shot of one color is the exact opposite of the previous weft shot of the other color, and the structure is sometimes described as 'woven on opposites'. The color diagonal is the same as the twill diagonal and both reverse on the opposite face.

p. 181, col. 2, line 4

* An exception to that rule can be found in a less common form of *simple gauze weave* in which two warps that would usually simply cross and re-cross each other instead make 'full-turns' round each other and do not exchange positions. As a result of this variation in the nature of the crossings each warp passes alternately over and under wefts.

p. 186, col. 2, 5th line from bottom

* Both warp and weft units are composed of paired yarns; the weft is red, while in the warp two red units alternate with two natural colored ones. The same two warp units (one of each color) cross and re-cross each other throughout. The crossings are 'full-turn' and there are two non-holding wefts after each gauze (or holding) weft. The direction of the crossing is reversed (countered) in successive columns and there are correlated reversals of the relationship of the two colors in each column, with the color relationship changing where the direction of the crossing does not, and vice versa. In contrast to regular *gauze weaves*, and as a result of the 'full-turn' crossing of warps, each warp unit passes alternately over and under successive wefts, as well as over or under its companion warp unit. (This and similar structures are sometimes described as 'irregular gauze'.)

p. 189, col. 2, par. 2, line 3

* But when transverse elements actually *cross* each other, exchanging positions, it usually can be safely assumed that one, at least, is not a *weft element* but an *accessory element* added or inserted by some subsequent process such as *embroidery*. Exceptions to this assumption are likely to be noted in early hand weaving, perhaps before the restrictions of tradition have been firmly established, and actual crossings of wefts are sometimes thought to indicate the work of more than one weaver.

About the Author

Irene Emery had a remarkable and diverse background. Born in 1900, she received her BA in philosophy at the University of Wisconsin. She also studied modern dance there with Margaret H'Doubler and later in New York with Martha Graham, becoming a member of the latter's original concert group. While dancing professionally, she also taught dance and studied sculpture under Alexander Archipenko. When an injury terminated her dancing career in 1930, she continued her study of sculpture under Emil Zetler at the Art Institute of Chicago. She then moved to Santa Fe, New Mexico, where she executed commissions in sculpture. When *myasthenia gravis* left her with insufficient strength for sculpture, she turned to needlepoint and then to weaving.

Her study of the literature, as well as examples of ancient fabrics, led her to become increasingly concerned with the haphazard and confusing terminology and descriptions she encountered. She began serious study of this problem at the Laboratory of Anthropology in Santa Fe in 1947, continuing at The Textile Museum, Washington, D.C., from 1954 until her death in 1981.

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